ILLUSTRATIONS

OF THE

COMPARATIVE ANATOMY

OF THE

NERVOUS SYSTEM.

BY

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SECOND EDITION.

LONDON:
BRADBURY AND EVANS, 11, BOUVERIE STREET.
1864.

LONDON:
BRADBURY AND EVANS, PRINTERS, WHITEFRIARS.

PREFACE.

The Author having had frequent occasions for referring to Comparative Anatomy during the progress of his publications on the Nervous System, he conceived that representations of his dissections might interest many, and especially assist those who were about to enter upon similar pursuits. But, on so comprehensive a subject, it became difficult to determine upon an arrangement that would make a work concise and useful. After much consideration, it appeared probable that this intention would be in a great measure answered by selecting such examples as would explain the scheme on which the nervous system is generally founded; for thus its practical investigation would be facilitated, and the extension of knowledge promoted in the best and most efficient manner.

It is desirable that researches by actual dissection should be encouraged as much as possible, as thus only can the prospective advantages of science be consulted. If books be entirely confided in, all improvement must stop. These ought, therefore, to be esteemed as mere helps towards that perfection, which can only be approached by the active perseverance of individuals through progressive ages. If the laborious investigations, hitherto instituted, have produced

incongruous opinions in physiology, let not their value be underrated, for it may reasonably be presumed, that the modifications of arrangement, which remain undiscovered, will harmonise the whole, and demonstrate the simplicity of unerring truth in this portion of the manifold and wonderful designs of the Creator.

In this Second Edition the letter-press has been carefully revised and rendered more concise. The descriptions belonging to each class of animals have been kept more separate and distinct. The plates remain exactly the same, but as particular drawings appeared to have been cramped by the limited size of the page in the first edition, a larger paper has been used in the present publication.

6, Tavistock Square,
April, 1864.

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INVERTEBRATA.

IN one of the most complicated of invertebrate animals, as the lobster, the brain is small, when compared with that of fishes; it gives off the optic nerves, nerves to the feelers, the organ of hearing and contiguous parts, and sends a long nerve on each side of the œsophagus, to give filaments to the stomach, and then join the first or subœsophageal ganglion, which sends branches to the mouth and adjoining parts. From the first ganglion the cord passes down to the next, and so on to succeeding ones as far as the tail; filaments are given off to the branchiæ, the muscles and integuments, and one passes to each extremity. The large artery supplying the extremities passes between the two halves of the cord just above the ganglion, giving off the nerves to the last pair of legs. The ganglia become smaller below those which have supplied the extremities. Nerves issue both from the ganglia and cord to contiguous parts; and the distinction between those passing from the dorsal or ventral surface is not clear. The nerves of the legs issue from the ventral surface. The posterior or dorsal layers do not send distinct fibrils to join the nerves issuing from the anterior or ventral, and the anterior do not send off branches forming distinct and separate ganglia in the same manner as the posterior origins in most of the vertebrate animals, but the ganglia are concentrated in the cord. There are more distinct and continued parallel lines on the dorsal surface than on the ventral. In another form, in which the body is more uniform throughout, as in the centipede, the brain gives branches to the feelers and eyes, and then sends a nerve on each side of the œsophagus to the ganglia beneath this; lower down the nervous system consists of a

chain of similar ganglia, which give off branches to the legs, the air-tubes, and other structures. In the leech the brain and ganglia are rather smaller than in the preceding, but the distribution of nerves is on the same plan. In the earth-worm, which is still more simple, the brain is very diminutive, and the long cord has the appearance of a nerve giving off lateral branches. There is another form of part of the nervous system, in which there is a thick ring instead of the lengthened chain of ganglia. In the crab the brain is seen giving off the optic nerves, and others to the feelers and contiguous parts, it then sends off the long nerve on each side of the œsophagus to give filaments to the stomach and branchiæ, and pass to the thick ganglionic ring; from this branches are sent towards the mouth, but the principal portion of its branches are given to the claws and tail. In the slug the nervous system approaches in some degree to that of the crab; the brain is placed above the dorsal portion of the œsophagus, and gives branches to the feelers and parts about the mouth: beneath the œsophagus there is a solid ganglion, instead of the ring in the crab, for supplying the fleshy foot, the integuments, the heart, and the digestive organs. In the whelk there is some resemblance of the nervous system to that of the slug, but it is still more simple; there is a double ring, through which the bloodvessel and intestine pass, and from which nerves are sent to the proboscis, the fleshy foot, and viscera.

The nervous system requires to be so adapted to the skeleton, that a sudden shock cannot easily be communicated to it, otherwise its functions would be liable to be momentarily and permanently annihilated. A peculiar conformation is also necessary for preventing a compression or overstretching of such parts of it as are subjected to motion; in the spinal cord this is answered by the small circumference of this organ when the motion of the vertebræ is considerable, and when it is still greater, as in the hedge-hog, by a long cauda equina, the short and thick spinal cord being placed where very little flexion is allowed. The same precaution is also required respecting the nerves, and is fulfilled by their mode of origin, their proper adaptation to the openings through which they are conducted, and their proportionate size to the parts they are connected with in their passage, as well as

to those they supply; without this careful arrangement, the motions of the bones and muscles might interfere with their functions, they might be too bulky for easy flexion and extension, or too slender for a connection with structures possessing considerable power and motion.

When the lengthened appendage to the brain, the spinal cord, ceased to be necessary, analogy would have pointed out as a substitute for it one or more nerves arising from a brain or ganglion, and giving off branches in its course to the contiguous parts. But it would have been difficult even to have conducted safely a simple cord along the moveable rings of some invertebrate animals. If parts of much extent were to be furnished, it must have proceeded from a large brain or ganglion; it must have been of considerable thickness, and therefore ill-accommodated to the surrounding structures; but it could not then have been even contained in the narrowed portions of the body of many insects; or, if it had been flat and extended, so as to have been fitted to the form of a sufficiently spacious external shell or covering, it might have been very inconveniently placed for giving off branches to the powerful muscles. Although one large ganglion is adapted to the oval form of the crab, it would have been very unsuitable to the lengthened body of the lobster, which requires the greatest portion of its nerves to pass in one direction. In the tail of the crab, a nerve of moderate size suffices for the slender muscles; but it would not for the large and powerful ones in that of the lobster. For producing, therefore, a convenient distribution of the nerves in the varying forms of many invertebrate animals, ganglia of different sizes have been adopted and placed at proper distances from each other.

In invertebrate animals the most simple form or type of the nervous system exists as a cord or ring giving filaments to the contiguous parts. In very numerous instances there is a brain or ganglion placed above or on the dorsal portion of the œsophagus, and a longer or shorter nerve passing from it on each side of this canal to the subœsophageal ganglion, situated below or on the ventral parietes; a nervous collar is thus produced, and when the subœsophageal ganglion is circular, there is the appearance of a double ring. From the brain and this ganglion the principal nerves

may be at once sent off; or there is a cord or prolongation, composed of two portions, more or less separated, and extending from the first ganglion to a second, and so on with respect to the rest. Generally the nerves arise from the ganglia, but sometimes from the prolongation also. The ganglia vary in number, and are larger or smaller in proportion to the quantity of nerves given off by each of them. They are more concentrated when the skeleton is round or oval, when the motion of the part on which they are placed is so constrained that their functions cannot be interfered with, and the extremities can be more conveniently supplied by them with nerves. In the crab there is one large ganglion for furnishing all the legs; and, in the spider, there is a similar disposition; in the lobster, whose skeleton is elongated, and its different parts more moveable, there are several; but those, beyond the one giving nerves to the last pair of legs, are much smaller than the rest. In the centipede, the ganglia are of an almost equal size throughout, and as numerous as the legs and the divisions of the skeleton; and thus a very free motion is allowed. Creatures like the leech, which are capable of great and sudden changes in the size of the body, derive the highest advantage from numerous ganglia, as these allow either a contraction or distension of the stomach without inconvenience; for, whilst a simple cord in the empty state might have been displaced sufficiently for interfering with the distribution of its branches, in the distended state it might have been over-stretched, and the functions of the whole impaired. In the slug, which is less capable of being subjected to similar inconvenience, because the variations of its alimentary canal are more limited, there is one principal ganglion besides the brain, from which the nerves arise. The changes that take place from the state of the larva to that of the perfect insect, demonstrate the necessity for a proper adaptation of the ganglia and nerves to the new form of the body. When a simple cord in the form of a long nerve does not suffice, a mass of ganglion, in larger or smaller divisions, proportionate to the requisite quantity of nerves, is provided, and placed in an appropriate form for corresponding with the shape as well as the locomotive necessities and other requisite changes of the body.

A great portion of the preceding observations refers to the centres and nerves

of invertebrate animals, and to the mode in which they are accommodated to the numerous forms of their respective bodies, and to the modifications of structure. It would be too presumptive to attempt to point out the functions of the different parts of the brain; nevertheless, when their intelligence is considered, also their special senses—the organs for prehending food and comminuting it, or for taking softer or more fluid kinds, their organs for digesting and assimilating the food, for circulating the blood, and for respiratory changes—it seems not unreasonable to conclude, and to attempt to point out, that the preceding attributes, forming a part of the plan of the animal creation, must be perfected by similar centres and nerves, however much they may be modified and contracted, to accord with more simple organs and such diversified bodies.

The small brain allows the necessary intelligence to be manifested, also sight, and some degree of hearing. It is probable the nervous cord passing on each side of the œsophagus is composed of a voluntary and sensitive tract, also of an involuntary one, which has similar functions to those of the par vagum; and when combined with the more sensitive quality in the ganglia, may answer all the purposes of the par vagum and sympathetic conjoined. Such a disposition accords with the brain, the oblong medulla and spinal cord of higher classes arranged in a different form of structure. The involuntary and sensitive qualities of the ganglia correspond with those of the spinal ganglia in the highest animals for giving auxiliary respiratory powers to the skin, and therefore in the invertebrate favour the functions of the branchiæ, the air-tubes and the viscera. In the highest animals the voluntary impulses proceed from distinct centres in the brain, and are conducted by corresponding tracts; the force and power of the muscles depend on the cerebellum and the large size of the oblong medulla and spinal cord; and therefore, by analogy, it may be concluded that the large ganglia in the invertebrate exist for supplying also the energy for the continuance of the swift motions in flight or other modes of progression, whilst a very small voluntary centre and tract suffice for the variations of motion such creatures require.

PLATE I.

DORSAL ASPECT OF THE CRAB.

(CANCER PAGURUS.)

The brain is seen giving off the nerves to the eyes and contiguous parts, and sending a long nerve on each side of the œsophagus, to supply filaments to the stomach and branchiæ, and pass backwards to join the nervous ring. The continuation of the nerves given off by the nervous ring to the legs is also exhibited. The nervous system in the fresh animal is very transparent.

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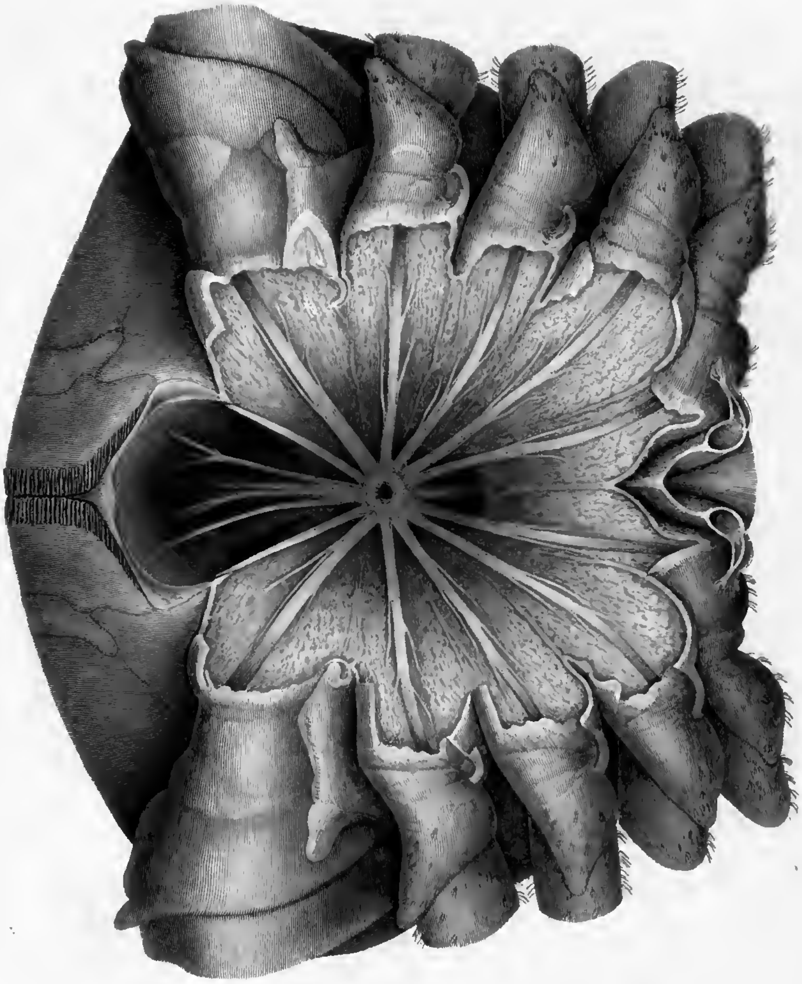

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PLATE II.

VENTRAL ASPECT OF THE CRAB.

(CANCER PAGURUS.)

The nervous ring is seen sending branches forward to the parts about the mouth, and to be joined by those passing on each side of the œsophagus from the brain; other branches are seen passing to the muscles of the thorax, to the legs, and the muscles of the tail. The tail is formed of many pieces, somewhat resembling the backs of the rings of the lobster, and in each of them slips of muscle are inserted for drawing it towards the thorax; the nerve divides into many branches, which terminate in the muscles, but there is not any appearance of ganglia, as in the tail of the lobster, scorpion, &c.

PLATE III.

DORSAL ASPECT OF THE LOBSTER.

(ASTACUS MARINUS.)

The brain is seen giving off the optic nerves, and others to the contiguous parts and the feelers, and sending a long nerve on each side of the œsophagus, which gives filaments to the stomach and joins its fellow at the first ganglion: the nervous cord is then continued from this ganglion to the next, and so on to the tail. The cord exhibits more distinct and continued parallel lines on the dorsal surface than on the ventral. The large artery, supplying the extremities, &c., is seen passing between the two halves of the cord, just above the ganglion giving off the nerves to the last pair of legs. Nerves are seen issuing from the ganglia and the cord, to be distributed to the contiguous parts. In this plate the origins of the nerves of the legs are obscured by others passing over them; but their continuations to the tips of the claws are seen.

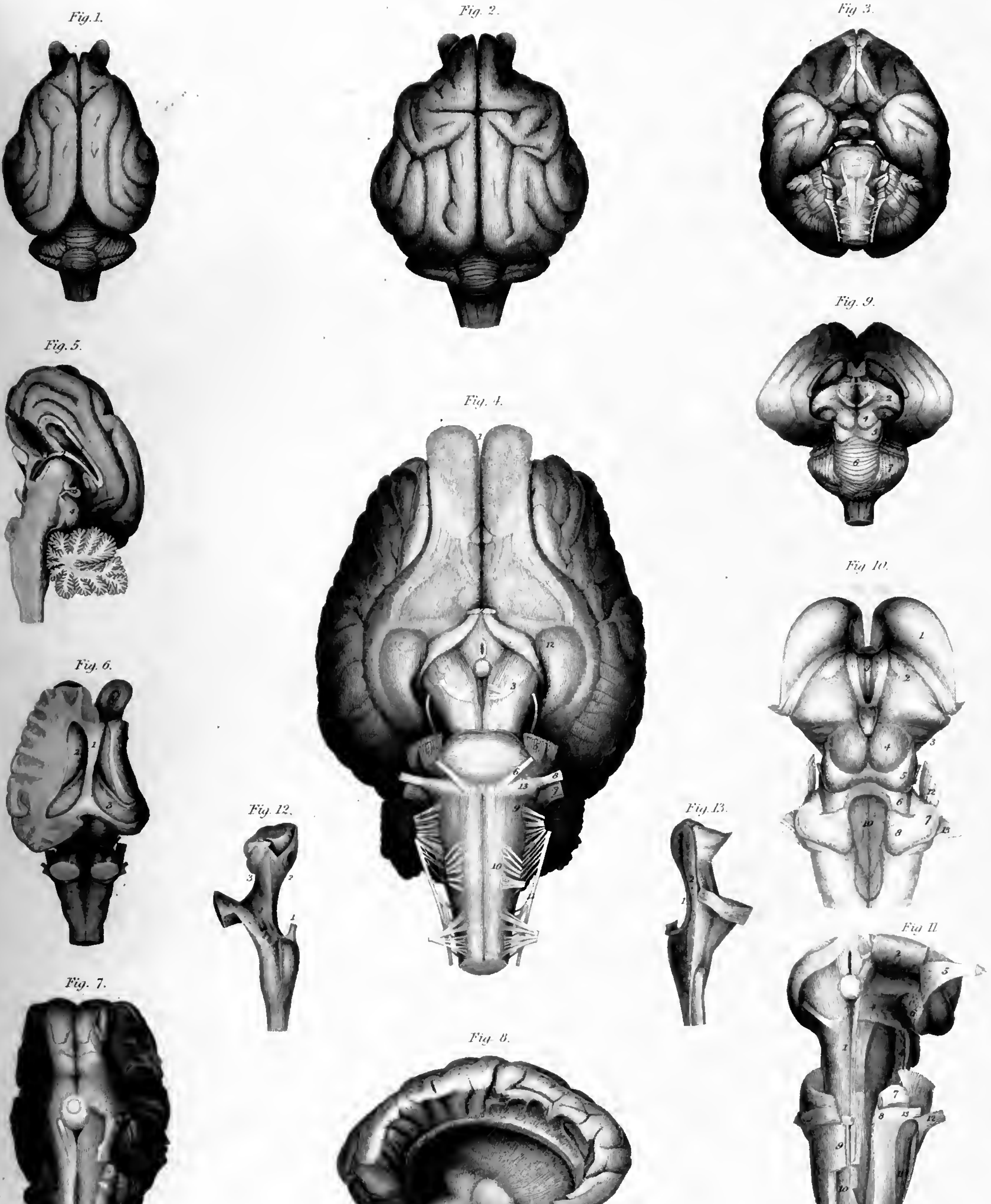

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Fig. III.

THE MONKEY.

(SIMIA.)

It shows the base of the brain and the origins of the nerves; also the small olfactory nerves; the small trapezoid bodies, the olivary bodies, and the lateral lobules of the cerebellum. The posterior horn of the lateral ventricle is not of the same small size in every species of simiæ, but varies with the size of the posterior lobe of the brain.

Fig. IV.

THE HORSE.

(EQUUS CABALLUS.)

It shows the base of the brain, and the origins of the nerves.

1. Olfactory nerve; its origin occupies a considerable part of the surface of the base of the brain, and is connected with the inferior part of the hippocampus. It forms a large bulb, which is placed over the cribriform plate of the ethmoid bone, and terminates in branches passing through the perforations in this to the Schneiderian membrane of the nose.
2. Commissure of the optic nerves, after the surface of the thalamus anteriorly has received the termination of the true visual tract; in passing posteriorly the optic tract becomes connected with the surface of the nates, the geniculate bodies, and with the mammillary body and the prominence surrounding it.

3. Third nerve, proceeding from the inner part of the crus of the brain: it arises from the smaller portion of the intermediate layer of the exterior region.

4. Fourth nerve, arising behind the quadrigeminal bodies at the roof of the passage from the third to the fourth ventricle.

5. Fifth nerve: the figure is placed on the smaller portion which proceeds outwardly from the upper margin of the trapezoid body; half of the origin of the larger portion is from the ventricular cord, forming the surface of the fourth ventricle, the other half is from the involuntary centre and reaches near the termination of the oblong medulla, forming a conical prominence on this; the smaller portion is on the inner side, and arises from the tract of the larger portion of the intermediate layer of the exterior region after it has been joined by the tract of the first convolution of the intercedent region: the larger portion undergoes a change in the arrangement of its fibrils in the Gasserian ganglion, and is then divided into three trunks.

6. Sixth nerve, arising from the trapezoid body in the groove on the outer side of the pyramidal body.

7. Auditory nerve, arising from the side of the fourth ventricle, and the exterior layer of the restiform body.

8. Hard portion of the seventh, connected externally with the trapezoid body: it arises from the tract of the larger portion of the intermediate layer of the exterior region, after it has been joined by the tract of the first convolution of the intercedent region.

9. Glosso-pharyngeal nerve and par vagum, arising from the involuntary tract, and having their egress at the side of the restiform body.

10. Ninth nerve, proceeding from the outer side of the pyramidal body: it arises from the continuation of the tract of the larger portion of the intermediate layer of the exterior region, after it has given origin to the smaller portion of the fifth, the sixth, and the hard portion of the seventh.

11. Accessory nerve.

12. Inferior part of the hippocampus.

13. Trapezoid body: it is formed of transverse fibres externally. Internally it is

composed of the tract of the larger portion of the intermediate layer, after it has been joined by the tract of the first convolution of the intercedent region. It gives origin to the smaller portion of the fifth, the sixth, the hard portion of the seventh, and to the ninth by its extension down the oblong medulla. It will be, therefore, observed that, whilst the smaller portion of the intermediate layer supplies the third nerve, the larger portion of the intermediate layer gives origin to the sixth, which is sent to the abductor and retractor muscles, and can oppose all the others; the fourth nerve, supplying the superior oblique muscle by its origin behind the quadrigeminal bodies, derives also some opposing power from the tracts proceeding to the restiform body.

Fig. V.

THE SHEEP.

(OVIS ARIES.)

It affords a side view of the brain, which has been divided at the median line.

1. Great commissure. 2. Anterior crus of the fornix. 3. Anterior commissure. 4. Nates. 5. Pineal gland.

Fig. VI.

(THE SAME.)

It shows the lateral ventricles laid open, and continued into the bulb of the olfactory nerve.

1. Attachment of the great commissure to the septum lucidum.

2. Striated body.
3. Continuation of the fornix and the great hippocampus.
4. Olfactory nerve, showing the continuation of the lateral ventricle.

Fig. VII.

(THE SAME.)

It shows the fibres proceeding from the pyramidal body and crus of the brain in their course to the great commissure and the convolutions, and on the right side the involuntary tract passing behind the crus of the brain.

Fig. VIII.

THE CALF.

(BOS TAURUS.)

The brain has been divided through the median line; it shows the continuation of fibres of the crus of the brain through the striated body and thalamus, also the margin of the great commissure and the convolutions.

PLATE III.

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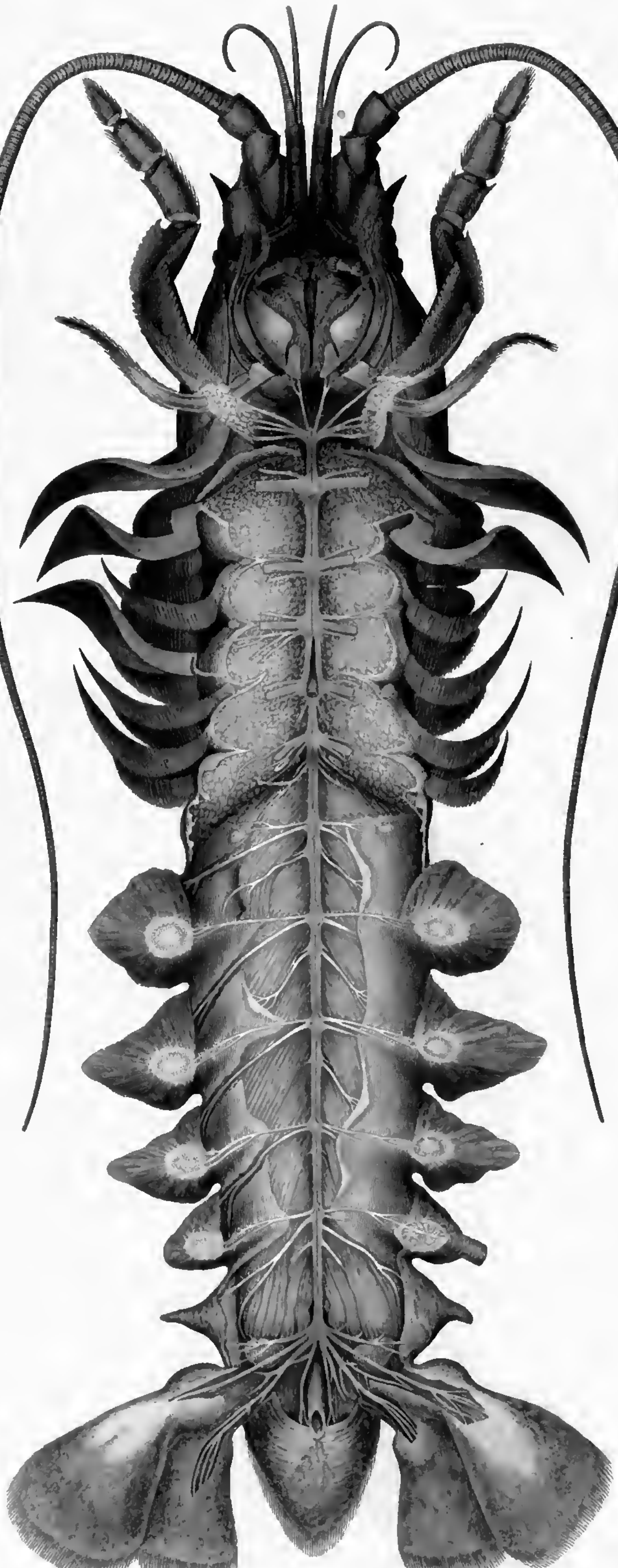

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PLATE IV.

VENTRAL ASPECT OF THE LOBSTER.

(ASTACUS MARINUS.)

THE greatest portion of the shell has been removed from the preparation from which this plate is taken. The nervous cord is seen about the first ganglion after the junction of the nerves passing on each side of the œsophagus from the brain. Branches are seen passing towards the mouth, and to the contiguous parts throughout the course of the cord; the nerves to be given to the legs are seen issuing from the ventral surface of the cord.

The posterior or dorsal layers of the nervous cord do not appear to send distinct fibrils to join the nerves issuing from the anterior or ventral; and the anterior do not send off branches forming distinct and separate ganglia, in the same manner as the posterior origins in most of the vertebrate animals; but the gangliform enlargements are concentrated in the cord.

PLATE V.

Fig. I.

THE CENTIPEDE.

(SCOLOPENDRA MORSITANS.)

This figure shows the brain, and the nerves passing from it on each side of the œsophagus to the first ganglion. It shows the nervous cord, with its numerous ganglia continued to the tail, and giving off branches in a similar manner throughout its course.

Fig. II.

DORSAL ASPECT OF THE EARTH WORM.

(LUMBRICUS TERRESTRIS.)

After removing the dorsal parietes the brain is seen, and the membranous sacs, or hearts, communicating with the dorsal bloodvessel.

PLATE I.

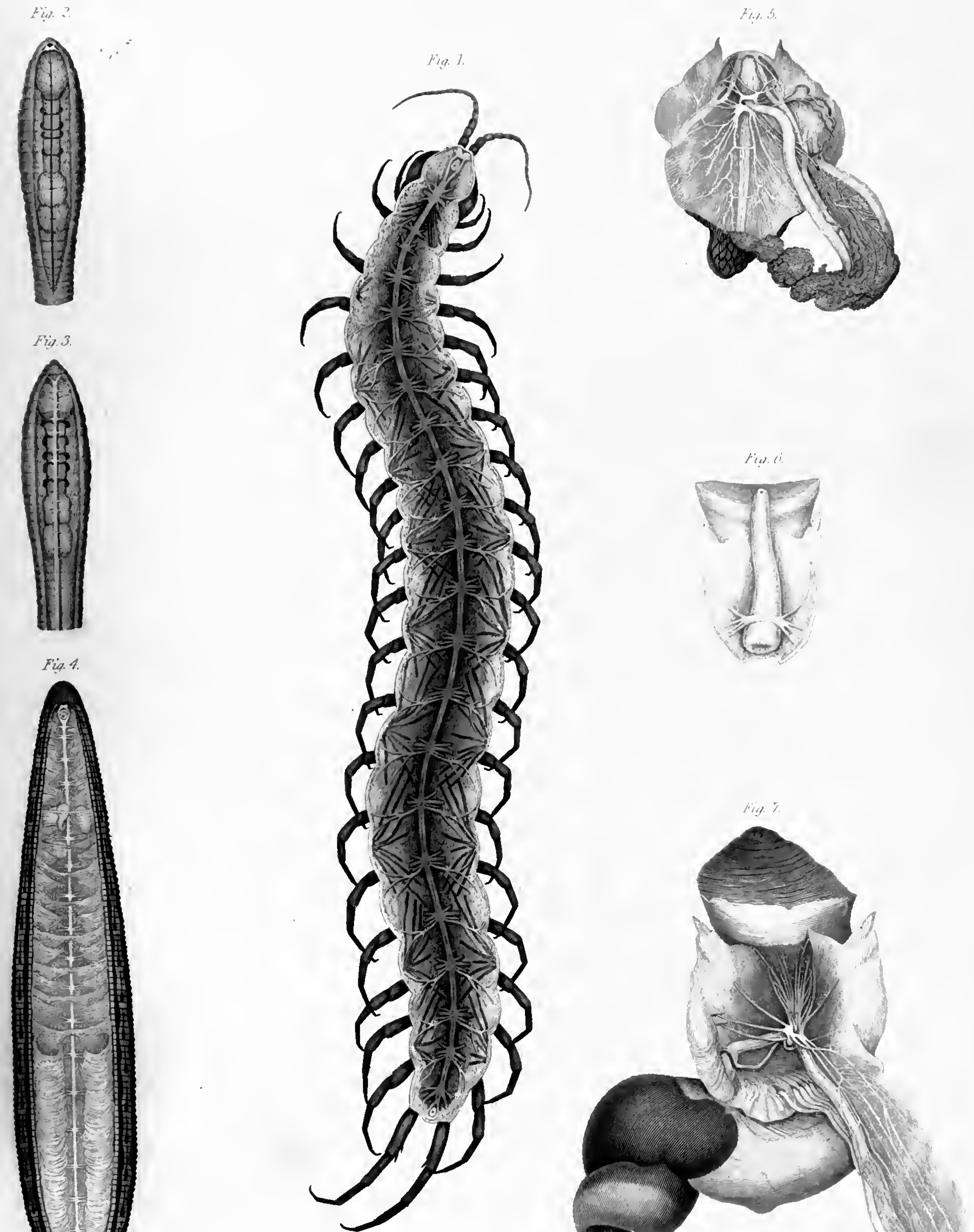

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Fig. III.

VENTRAL ASPECT OF THE EARTH WORM.

(LUMBRICUS TERRESTRIS.)

After removing the ventral parietes the nerves are seen passing on each side of the œsophagus from the brain to the nervous cord. A bloodvessel is seen passing on the nervous cord throughout its whole length; the large ventral bloodvessel is seen, and its communications with the membranous sacs, or hearts.

Fig. IV.

THE LEECH.

(HIRUDO MEDICINALIS.)

This figure shows the brain of the leech placed above the œsophagus, and the nerve passing from it on each side of this canal to the first ganglion; the nervous cord is seen extending throughout the length of the body on the ventral parietes, and its several ganglia sending off nerves to the contiguous parts.

Fig. V.

THE SLUG.

(LIMAX ATER.)

The slug was opened on the dorsal surface; the brain is seen placed above or on the dorsal portion of the œsophagus, and giving filaments to the feelers, and the parts about the mouth; a ganglion is seen larger than the brain, placed beneath or next the ventral surface of the œsophagus, and connected by a narrow band with the brain. The nerves are seen proceeding from the ganglion principally to the fleshy foot and integuments, and giving some small branches to the heart and digestive organs.

Fig. VI.

THE WHELK.

(BUCCINUM UNDATUM.)

After dividing the surface from the edge of the broad end of the foot towards the parts contained in the apex of the shell, a pink substance resembling a ganglion is seen on the proboscis; it is connected by filaments on each side to the contiguous parts and the nervous ring.

Fig. VII.

THE WHELK.

(BUCCINUM UNDATUM.)

This figure shows the principal part of the nervous system in a ring divided into two parts, and encircling a bloodvessel and the alimentary canal. The proboscis has been turned aside for allowing some of the nerves to be seen terminating on this part, and others on the fleshy foot.

PISCES.

BRAIN.—In an osseous fish, as the cod, the anterior lobes of the brain are small; the optic lobes are much larger. The ventricle is continued from the anterior lobes; it passes under a commissure between the optic lobes into them, and under the cerebellum to the calamus scriptorius. The ventricular cords on its floor are not so distinct as in the skate. The cerebellum consists principally of a middle lobe, the anterior point of which extends into the ventricle of the optic lobes: it has a very small ventricle. At the base the anterior lobes are again partly seen, and the small olfactory nerves proceeding from them. The pituitary gland is also seen, and the large mammillary eminences; and behind these is the continuation of the oblong medulla, which is very slightly different from the spinal cord. In a cartilaginous fish, as the skate, there are similar parts; but the anterior lobes of the brain are much larger than in the cod, in proportion to the optic lobes; the ventricular cords are more distinct. The cerebellum is larger; it has a larger ventricle. At the base the large anterior lobes of the brain are again seen, and smaller mammillary eminences. The oblong medulla and spinal cord are not very different from the same in the cod except in size. In the cod the small olfactory nerve proceeds from a small anterior lobe, and forms a bulb or ganglion over the nose, from which nerves pass to the membranous plaits; in the skate it is larger, and proceeds from a much larger lobe: it forms a larger ganglion, and its termination is similar. In the cod the optic nerve is larger, and proceeds from the optic lobe and mammillary eminence, and decussates its fellow after its origin; in the skate it is similar, but smaller, and does not decussate its fellow,

as in the cod. The third nerve arises from the oblong medulla in the track of the pyramidal body, a little behind the mammillary eminence; it supplies all the muscles of the eye, except the superior oblique and abductor, and furnishes ciliary nerves. The fourth arises just behind the posterior point of the optic lobe from the roof of the ventricle; it terminates on the superior oblique muscle. The fifth arises from the restiform body in the cod, and divides into several large trunks. In the skate the fifth has two origins, one from the restiform body, the other from the pedicle or process of the oblong medulla at the side of the cerebellum; it divides into three distinct trunks. In the cod the first trunk has two origins near to the brain; it proceeds forward, and sends a branch towards the nose, and terminates on the skin in its progress to the snout. In the skate it has two origins, one of which passes under, and the other over, the attollent and superior oblique muscles of the eye, and they join just beyond; it sends a branch to the nose, and then terminates in the skin and cellular tissue in its progress to the snout. In the cod and skate large branches, compared with the second and third trunks, pass to the palate and skin and muscles, and in the skate to the cellular tissue; in the cod a branch of the third trunk passes to the pendulous barb, whilst in the skate it forms a ganglion at the angle of the mouth. There is a posterior trunk in the cod for communicating with the trunk of the par vagum, and then with all the nerves of the fins and the other spinal nerves as far as the tail; in the skate this does not exist. The sixth nerve arises from the oblong medulla, and terminates in the abducent muscle. The auditory nerve in the cod arises from the restiform body near the fifth, to terminate in the semicircular canals, one branch being joined by a filament from one of the bundles passing to the trunk of the par vagum, for forming a crescentic nerve to terminate in the sack containing the stone. In the skate the auditory nerve is a portion of the fifth; it terminates on the semicircular canals and sacks of the labyrinth; the branch supplying the large sack is joined by a branch of the glosso-pharyngeal, which also supplies a branch to a semicircular canal. The hard portion of the seventh does not exist. In the cod, one of the bundles passing to the par vagum resembles the glosso-pharyngeal, and particularly as it sends a branch to join one from the auditory for forming the crescentic nerve for the sack containing the stone. In the skate, the

glosso-pharyngeal nerve arises from the restiform body; it is distinct; it sends a portion to communicate with the auditory nerve on the large sack of the labyrinth, and the termination of one of the semicircular canals; the rest of the nerve passes to terminate on the first division of the gills and the membrane of the mouth. In the cod the par vagum arises from the restiform body, gives branches to the gills and muscles connected with them, sends two branches downwards and outwards underneath the skin of the side, and a larger one, which is the continuation, to terminate on the stomach. In the skate it is similar; the nerve given to the surface of the body first passes underneath the muscles of the back in contact with the spinal nerves; it then emerges from these near the tail, and is continued to the end of this covered only by the skin.

SPINAL CORD AND NERVES.—In the cod, the spinal cord is continued from the oblong medulla, gradually decreasing to the tail, where it terminates in a bulb: it gives off anterior and posterior bundles of nerves. Each anterior and posterior bundle is divided into two parts; one from the anterior is joined by one from the posterior, and passes forward to the muscles and skin on the anterior part of the spine: the other branch of the anterior, after it has communicated with the posterior branch passing forward, goes backwards, and is joined by the second branch of the next posterior bundle, to terminate on the muscles and skin at the posterior part of the spine. Neither of the branches of the posterior bundle forms a ganglion. The same disposition is continued to within a short distance of the tail, where the whole of each anterior and posterior bundle becomes joined, and the division into branches for the anterior and posterior parts of the spine takes place. In the skate the spinal cord is similar; but a ganglion at the extremity was not observed, and the disposition of the spinal nerves is more simple than in the cod at their origins, and each of the posterior forms a small ganglion: the arrangements of the spinal nerves are afterwards different, in respect of the absence of small fins, and in the formation of some larger trunks corresponding with the axillary plexus.

SYMPATHETIC NERVE.—In the cod, the sympathetic nerve arises from a branch of the fifth, the glosso-pharyngeal, and par vagum: a branch from the left side passes across to the right side, to form a ganglion from which proceeds the splanchnic

nerve, and, after communicating with the par vagum, it terminates in the intestines and other viscera. The prolongation is then continued down on each side of the aorta to the tail, giving filaments to the arterial branches and spinal nerves, and near the anus sending off filaments which unite and accompany the spermatic artery to the ovaries. In the skate the sympathetic is different; its consistence is softer; it forms a large ganglion, the branches of which may be traced to accompany the mesenteric arteries to the viscera. Some filaments also are distributed about the testes, and others pass towards the aorta; but these were very soft, and not satisfactorily traced to their precise terminations.

In fishes, in addition to the sensitive, voluntary, and involuntary divisions of the nervous system, there is also a sympathetic nerve. The parts of the brain concerned in the special and common sensitive functions occupy a very large share; a very small portion of it, therefore, remains for forming voluntary centres; but such agree with the simple voluntary impulses required for animals having such a medium to move in, and whose skeleton allows only simple motions. The involuntary portion gives origin to the glosso-pharyngeal and par vagum which supply principally the branchiæ and stomach, but the par vagum sends large branches on the sides for favouring respiratory functions when the branchiæ are not sufficient. In some instances ganglia are not attached to the spinal nerves, and in others are very small, and therefore cannot give the respiratory properties to the skin.

From the higher condition of all the organs of the senses, the intellect must receive more vivid external impressions; but whether it has higher intrinsic powers on account of the larger brain than some of the invertebrate is very doubtful. Fishes inhabit water in every part of the globe, and are required to subsist on various sorts of nourishment; and as they must therefore have different capacities, they must have corresponding variations in the structure of their bodies. The appetite for food appears to be their predominant desire, and providing for its gratification to form their chief occupation; and as this, in many instances, is very voracious, they must be constituted not only with a peculiar digestive apparatus, but with subtlety for taking their prey, and strength for pursuing it, as well as for defending themselves

against the attacks of their adversaries. To the varying functions of different organs, therefore, the nervous system is appropriately adapted. When the sense of smelling is most conducive to their convenience, there is a more capacious nose, large olfactory nerves, and larger anterior lobes of the brain; and when seeing is more advantageous, the anterior lobes are smaller, and the olfactory nerves decrease in the same ratio,—the eyes are consequently large, and the optic nerves and parts of the brain from which they originate are commensurate with them. Besides the different form and size of the several portions of the brain generally existing, it is furnished with additional lobes when modified powers are necessary.

PLATE VI.

THE SYMPATHETIC NERVE OF THE COD.

(GADUS MORRHUA.)

In the preparation from which this plate has been taken, the parts constituting the thorax, the abdominal muscles and portions of the gills have been removed; the œsophagus has been detached, and the air-bag laid open; the bloodvessels are seen passing down from the gills and uniting and sending off the mesenteric artery and forming the aorta to be continued down the middle of the spine.

a, œsophagus; *b*, stomach; *c*, liver; *d*, right ovary.

1. Large branches of the fifth supplying the muscles and skin of the head and face and membrane of the mouth.
2. A nerve proceeding from one of the bundles about to form a trunk of the par vagum; it communicates with the auditory nerve, and passes to the first partition of the gills, and gives off filaments to the pectinated processes.
3. Right trunk of the par vagum, giving branches to the gills and muscles connected with these parts, sending two outwards and downwards underneath the skin of the side, and a larger one to the stomach.
4. A small branch, given off by the trunk of the par vagum to pierce the air-bag and terminate on the parenchymatous structure, similar in appearance to the lungs.

PLATE VI.

Drawn by West.

5. Sympathetic nerve. Its origin appears to be first a branch of the fifth; it passes down and becomes connected with the nerve 2, then with the trunk of the par vagum, and afterwards with each of the spinal nerves. On the left side, after sending a filament to join the trunk of the par vagum on the stomach, it sends a branch across to join its fellow on the right side, in the splanchnic nerve. This forms a ganglionic enlargement on the mesenteric artery; and, after communicating with the right trunk of the par vagum, terminates in the intestines and other viscera. On each side of the aorta the prolongation of the sympathetic is continued down to the tail, giving filaments to the lateral branches proceeding from the aorta, and communicating with the spinal nerves. Near the anus filaments are sent off, which unite and accompany the spermatic artery to the ovaries.
6. Junction of the branches from the sympathetic of each side, to form the splanchnic nerve.
7. Spermatic nerves.

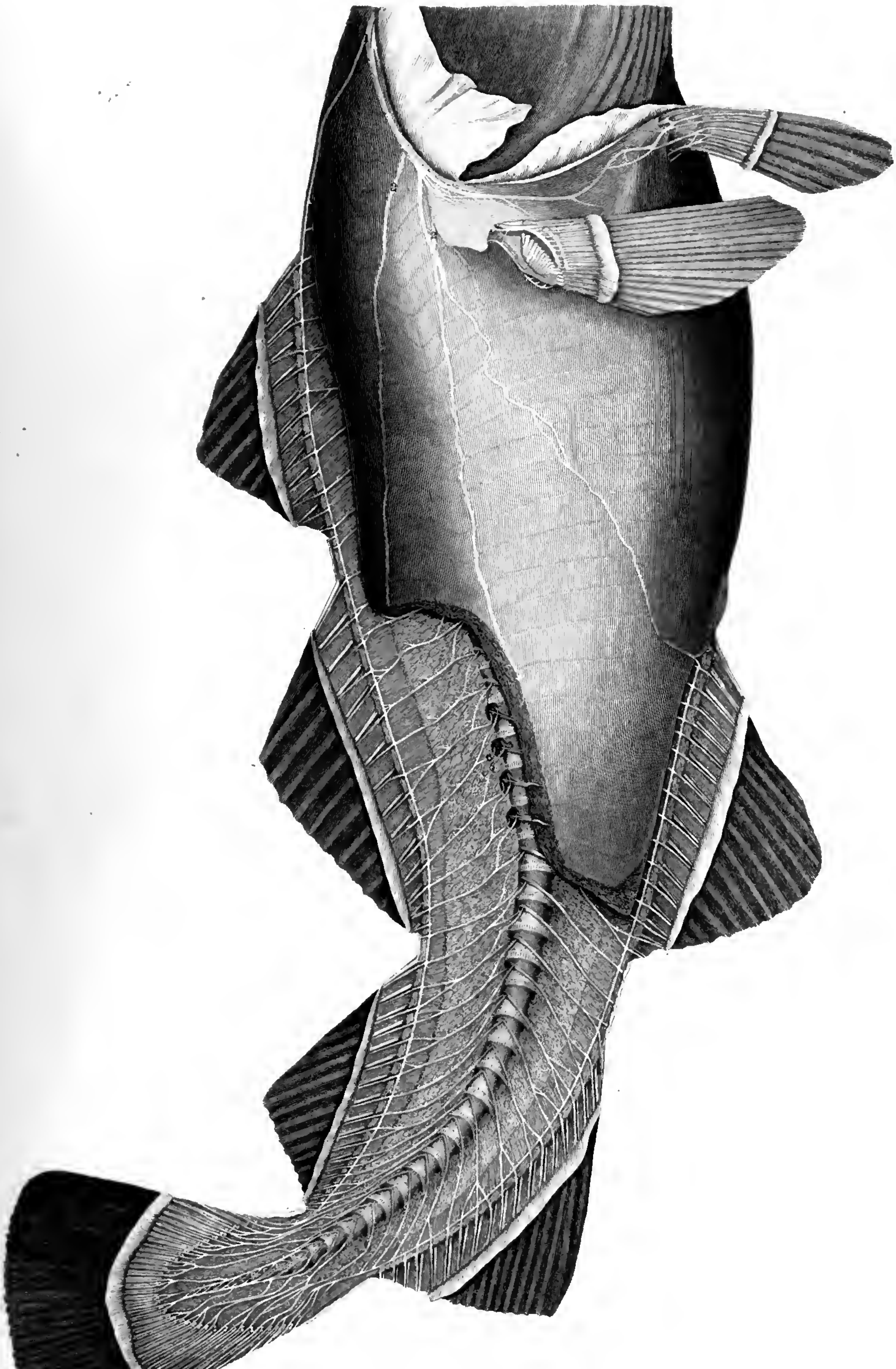
PLATE VII.

THE SPINAL NERVES OF THE COD.

(GADUS MORRHUA.)

1. A LARGE branch of the fifth, joined by a filament from one of the bundles about to form the par vagum, just as it issues from the posterior part of the head. It divides, and sends a branch downwards, close to the spinous processes, and communicates with all the branches of the spinal nerves passing towards the dorsal fins; another communicates with the nerves supplying the jugular and pectoral fins; a third is directed towards the abdomen, and passes down to the tail, to communicate with the nerves of the ventral fins. Besides these branches, others are given off by it to the skin at the back of the head.
2. Two branches from the trunk of the par vagum, passing downwards on the side underneath the skin; one is directed towards the tail, the other towards the back.
3. Part of the anterior origin of a spinal nerve passing forwards.
4. Part of the posterior origin of a spinal nerve passing forwards.
5. Part of the anterior origin of the same spinal nerve passing backwards.
6. Part of the posterior origin of the same spinal nerve passing backwards.

The disposition of the spinal nerves is very interesting. Each anterior and posterior bundle, issuing from the spinal cord, is divided into two branches. One branch



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from the anterior bundle is joined by one from the posterior, and passes forward to the muscles and skin on the anterior part of the spine; the other branch of the anterior bundle, after it has communicated with the posterior branch passing forward, passes backward, and is joined by the second branch of the next posterior bundle, to terminate on the muscles and skin on the posterior part of the spine. Neither of the branches of the posterior bundle forms a ganglion.

The same disposition of the spinal nerves is continued to within a short distance from the tail, when the whole of each anterior and posterior bundle becomes joined, and the division into branches for the muscles and skin, on the anterior and posterior parts of the spine, takes place. The spinal cord terminates in a bulb near the tail.

PLATE VIII.

THE COD.

(GADUS MORRHUA.)

Fig. I.

THE DORSAL ASPECT OF THE BRAIN AND SPINAL CORD.

a. Anterior lobes of the brain.

b. Optic or posterior lobes of the brain.

c. Cerebellum.

1. Olfactory nerve, arising from the anterior lobe of the brain, and passing forward and forming a round ganglion near the nose, from which branches are sent to the membranous plaits or folds exposed on the left side.
2. Optic nerve.
3. Third nerve, giving branches to all the muscles of the eye, except the superior oblique and abductor, and sending ciliary branches to the interior of this organ.
4. Fourth or pathetic nerve, arising just behind the posterior point of the optic lobe.

Fig. 1.

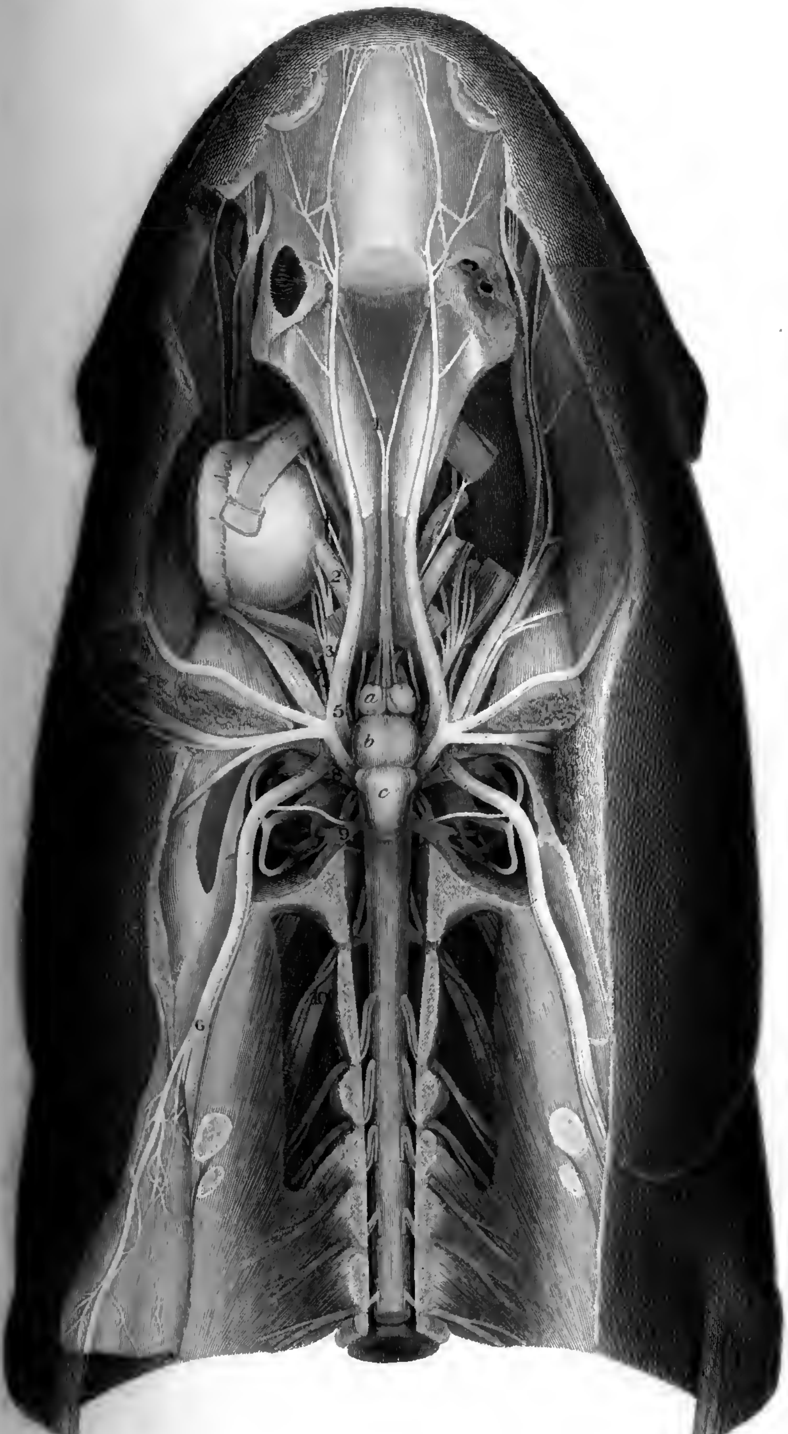

Fig. 2.

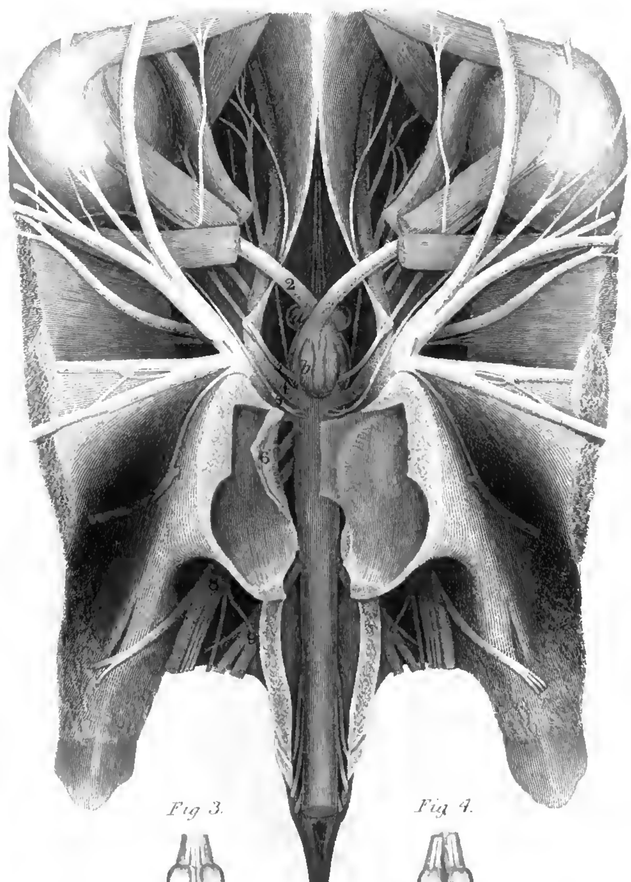

Fig. 3.

Fig. 4.

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5. Fifth nerve, arising from the restiform body, and dividing into several large branches, to be distributed on the muscles and skin of the head and face; many of those given to the skin pass in filaments through openings in the bone.

6. Posterior branch of the fifth, receiving a filament from one of the bundles about to form the trunk of the par vagum, and being continued to communicate with the nerves of the fins, as in 1, Plate VII.

7. Sixth, or abducent nerve.

8. Auditory nerve, arising from the restiform body, near the fifth, and giving branches to the semicircular canals, and the sac containing the stone.

9. Trunk of the par vagum, arising from the restiform body.

10. First spinal nerve.

Fig. II.

THE BASE OF THE BRAIN, AND THE ORIGINS OF THE NERVES.

a. Anterior lobes of the brain.

b. Mammillary eminences, which are much larger than in the skate; the pituitary gland has been removed.

1. Olfactory nerve.

2. Optic nerve, arising from the optic lobe and the mammillary eminence, and crossing its fellow to terminate in the retina.

3. Third nerve, arising from the base of the brain, in the track of the pyramidal body, a little behind the mammillary eminence.

4. Fifth nerve, arising entirely from the restiform body.

5. Sixth nerve, arising from the base of the brain, in the track of the pyramidal body.

6. Crescentic nerve, expanded on the sac containing the stone; it originates from a branch of the auditory nerve and a filament from one of the bundles about to form the trunk of the par vagum.
7. A branch from the par vagum to the first partition of the gills; it may be compared with the glosso-pharyngeal in the skate.
8. Trunk of the par vagum, arising from the restiform body; this is the last of the cerebral nerves.
9. First spinal nerve.

Fig. III.

Part of the optic lobe has been removed for exposing the ventricle, which is continued from near the anterior lobes; it passes under a commissure between the optic lobes, and is continued under the cerebellum to the calamus scriptorius; the longitudinal bands or columns on its floor are not so distinct as in the skate. The anterior point of the cerebellum, which was previously concealed, enters into the ventricle of the optic lobes. There is not so distinct a cavity in the cerebellum as in that of the skate.

Fig. IV.

The greatest part of the cerebellum has been removed from the preparation from which the preceding figure was taken, for showing the continuation of the ventricle to the calamus scriptorius.

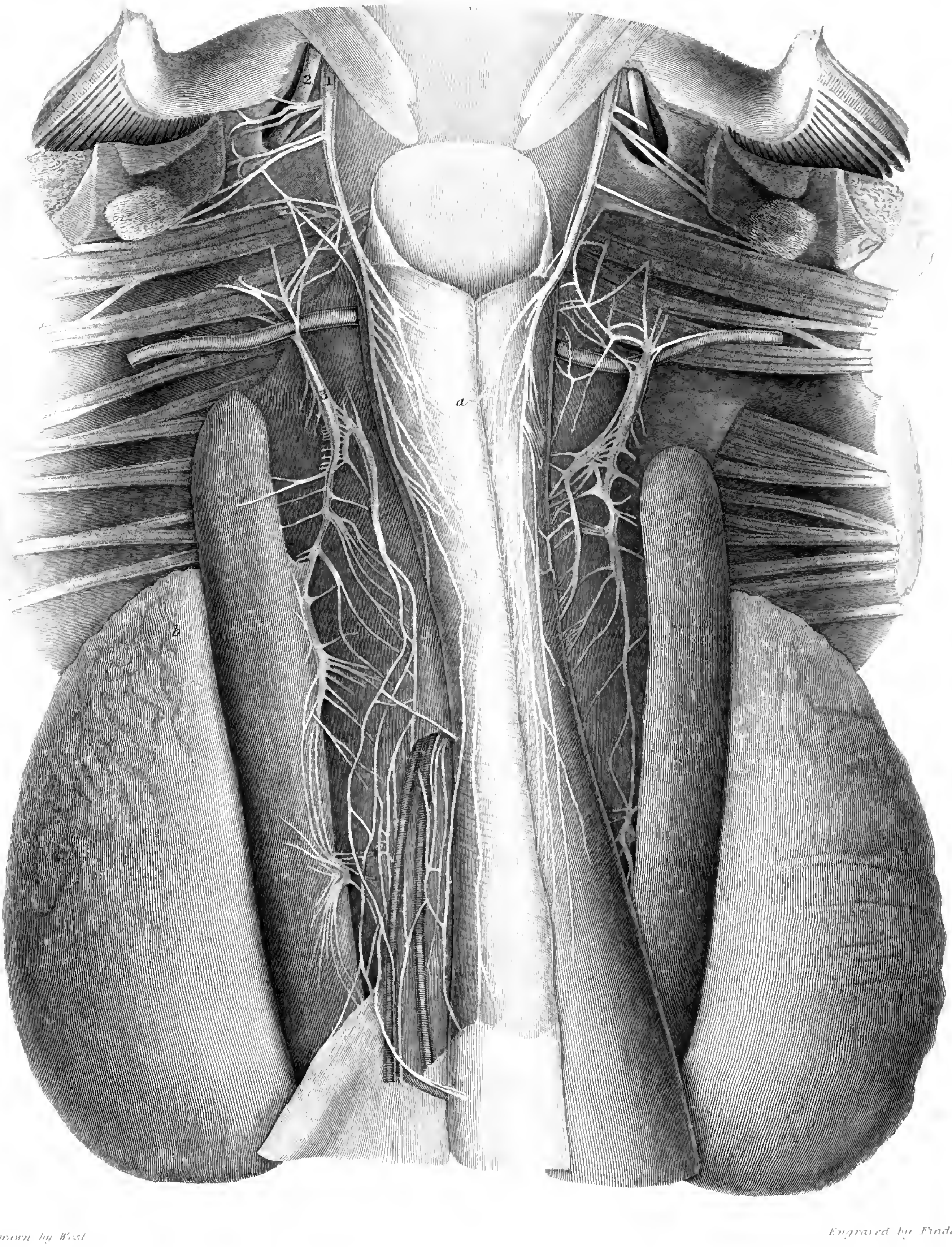

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PLATE IX.

THE SYMPATHETIC NERVE OF THE SKATE.

(RAIA BATIS.)

On each side of the superior part of the abdomen, at a short distance from the spine, the sympathetic nerve forms an unequal oblong ganglion of a red-ash colour; it gives off both large and very small nerves, having this appearance, to pass on the mesentery, communicate with branches of the par vagum, and accompany the mesenteric arteries to the viscera. Some filaments are distributed about the testicles, and others pass towards the aorta; but these are too soft to be satisfactorily traced to their precise terminations. The large ganglion communicates by a semitransparent tissue with a small one—this with the next, and so on to some distance down the spine; it communicates by the same tissue with the par vagum, and the large nerves collected from the spinal cord, which resemble the axillary plexus of the higher classes.

This engraving is of the full size of a preparation made from a skate weighing upwards of thirty pounds. It is taken from the part just above the last gill; the stomach was divided longitudinally, and then had a portion removed from each cut edge, so that it might be narrowed as much as possible, for giving room for the delineation of the large ganglion of each side. On the right side, the nerves

accompanying the mesenteric artery are more particularly shown, and some filaments forming communications with those of the left and the par vagum.

a. Stomach; *b.* Testis.

1. Ventricular branch of the par vagum.
2. Posterior branch of the par vagum.
3. Large ganglion of the sympathetic nerve.

Fig. 1.

Fig. 2.

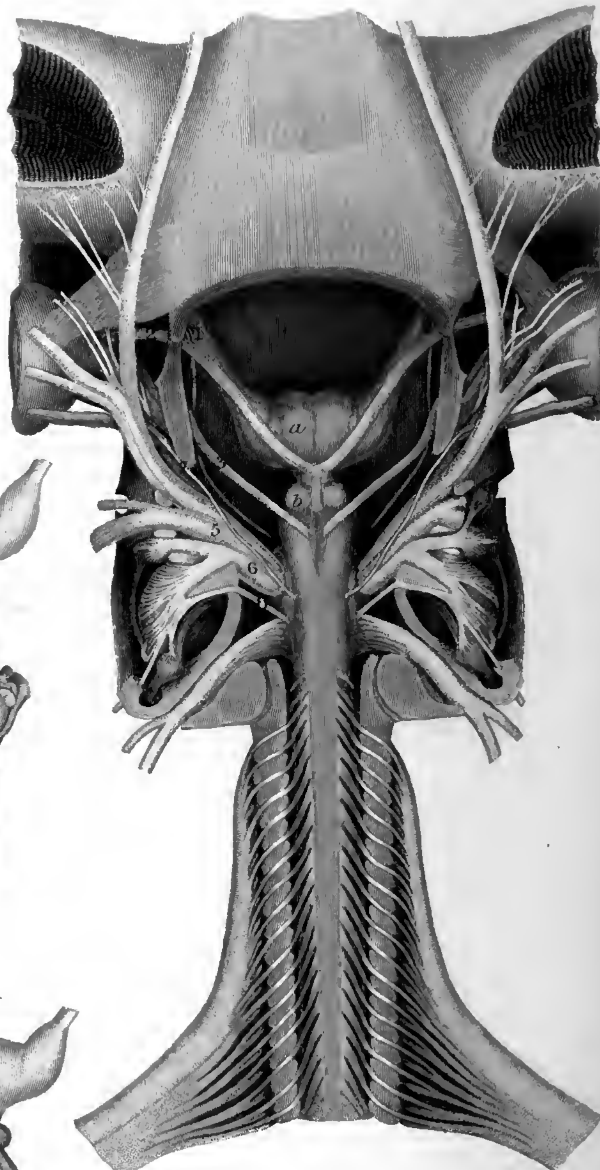

Fig. 3.

Fig. 4.

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PLATE X.

THE SKATE.

(RAIA BATIS.)

FIG. I.

THE DORSAL ASPECT OF THE BRAIN AND SPINAL CORD.

a. ANTERIOR lobes of the brain. *b.* Pedicles of the anterior lobes, corresponding with the crura of the brain. *c.* Optic lobes. *d.* Cerebellum. *e.* Nose.

1. Olfactory nerve; it arises, or is continued from the anterior lobe; it passes out of the cavity of the skull, and forms a long ganglion over the nose, which gives off numerous branches to pass through holes in the membrane, corresponding with the cribriform plate of the ethmoid bone, to the membranous plaits or folds of the nose.
2. Optic nerve.
3. Third nerve passing to all the muscles of the eye, except the superior oblique and the abductor.
4. Fourth or pathetic nerve: it arises just beyond the posterior point of the optic lobe.

5. Fifth nerve; it appears to have two origins; one from the restiform body, the other from a pedicle or process of the oblong medulla at the side of the cerebellum. There is an intermixture of different portions as in a ganglion.
6. Par vagum; it arises in a lengthened row of fibrils from the restiform body. This is the last of the cerebral nerves.

Fig. II.

THE BASE OF THE BRAIN, AND THE VENTRAL ASPECT OF THE SPINAL CORD.

a. Anterior lobes of the brain; *b.* Mammillary eminences; *c.* Nose.

1. Olfactory nerve.
2. Optic nerve; it proceeds from the optic lobe and mammillary eminence, and the pedicle of the anterior lobe; there is an interlacing of the nervous fibres just before the nerves separate.
3. Third nerve; it arises from the base in the track of the pyramidal body, a little behind the mammillary eminence.
4. Fourth nerve.
5. Fifth nerve; it arises from the restiform body and from the pedicle or process of the oblong medulla at the side of the cerebellum.
6. Auditory nerve; it is a portion of the fifth; it gives branches to the enlargements of the semicircular canals and the sac of the labyrinth, and communicates on this with the glosso-pharyngeal nerve.
7. Sixth, or abducent nerve; it arises from the base of the brain in the track of the anterior pyramidal body, and terminates in the abductor muscle of the eye.
8. Glosso-pharyngeal nerve; it arises just behind the upper portion of the par vagum: indeed, it would seem to be a part of the same, and only ascending

from this to communicate with the auditory nerve before it reaches its destination. It communicates with the auditory on the large sac of the labyrinth, and gives filaments to the termination of a semicircular canal; it then passes out to give filaments to the surface of the first and that of the opposite one of the adjoining division of the gills, and the membrane of the mouth.

Fig. III.

It shows the ventricle extending from between the crura of the anterior lobes into the optic lobes and the cerebellum. Parts of the processes of the oblong medulla giving origin to portions of the fifth nerve have been removed, and the ventricle has been exposed for showing its communication with the ventricles of the brain.

Fig. IV.

The cerebellum has been removed for showing the ventricles throughout to the calamus scriptorius.

PLATE XI.

THE DORSAL ASPECT OF THE NERVOUS SYSTEM OF THE SKATE.

(RAIA BATIS.)

The olfactory nerve is seen passing to the nose and forming a large ganglion, which is perfect on the right side, but on the left has been partly removed for showing the cribriform membrane through which the nerves pass to the membranous olfactory plaits. On the right side, the optic nerve is seen passing to the eye; on the left, it has been removed for giving a better view of the branches of the fifth. The third nerve is seen passing to all the muscles of the eye, except the superior oblique and abducent. The fourth is seen passing to the superior oblique muscle. The fifth is seen giving off three principal trunks besides the auditory; the first passes in two divisions through the orbit, these become united at the anterior part of this cavity, and the nerve is then continued forwards, giving branches to the cellular structure in its course towards the end of the snout: the second trunk passes on the fore part of the muscles of the jaw, gives a large branch which distributes branches on these muscles and the upper and lower lips; it gives a large branch to the cellular structure on the ventral surface of the snout, this also gives branches to the upper lip; it gives a large branch to the cellular structure at the side of the head: the third trunk passes behind the muscles of the jaw, gives branches to these, and is distributed on the skin about the mouth and gills; one of its branches forms a ganglion, which gives off

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filaments to terminate about the under lip. The auditory portion of the fifth passes to the ear, and gives branches to the sacks containing the cretaceous matter and the globular enlargements of the semicircular canals, whilst a nerve, similar to the glosso-pharyngeal, communicates with it on the large sack, and gives filaments to the termination of a semicircular canal, and then passes outwards to give filaments on the surface of the first and the corresponding one of the second division of the gills, and terminates on the membrane of the mouth. The par vagum is seen passing to the gills, giving filaments to the muscular appendages of these, and then sending a large branch to distribute filaments to every part of the opposite surface of each division, except the first; it sends a branch anteriorly to the stomach, which communicates with the sympathetic; it sends a large branch posteriorly to pass underneath the muscles of the back, and give filaments to these in its course; this branch lies upon and crosses the spinal nerves; near the tail it emerges from underneath the muscles, and passes just under the skin to the extremity of this part; it has been carefully examined, but communications between it and the spinal nerves have not been satisfactorily observed.

The spinal cord is seen gradually decreasing as it extends towards the tail. Each posterior bundle of the spinal nerves terminates in a ganglion, and is joined by a corresponding anterior bundle; it is then continued outwardly, and becomes connected with several others from the upper part of the spinal cord, to form a large mass of nerve somewhat like the axillary plexus. Lower down other junctions take place, but these are smaller, being composed of fewer nerves. The nerves thus formed pass forward, and then divide into branches for the anterior and posterior surfaces of the body. The posterior divisions send off small branches which pass between the long cartilaginous ribs or processes, and supply the muscles and skin. The anterior division passes forward in a similar manner, and, after sending up branches to the muscles of the chest, and others to those of the abdomen, is continued forward over the anterior surface of the body, and divides into branches to be distributed in a similar manner to those on the posterior part.

1. First trunk of the fifth, formed of two parts.
2. Branches of the second trunk of the fifth.
3. Third trunk of the fifth.
4. Glosso-pharyngeal nerve.
5. Trunk of the par vagum.
6. Ventricular branch of the par vagum.
7. Dorsal branch of the par vagum.
8. One of the spinal nerves.
9. The branch of the spinal nerve passing to the muscles, &c., at the anterior or under surface of the body. All the other spinal nerves divide in a similar manner, except that when several, as in the upper part, join together into a trunk, part of the trunk thus formed passes to the anterior or under surface, and then divides into branches as it does on the posterior surface.

The glosso-pharyngeal nerve communicates with the portion of the auditory on the sack of the labyrinth, and, after giving filaments to the surface of the first, and the corresponding one of the second division of the gills, terminates on the membrane of the mouth. This nerve, on being touched near its origin in a recently dead animal, immediately produces a contraction of the muscular appendages of the gills. Does it, therefore, communicate with the auditory nerve for the purpose of imparting contractile power to the sack containing the cretaceous matter, or is it for allowing this portion of the gills to receive sonorous impulses, and communicate them to the nerve spread on the sack?

AMPHIBIA.

BRAIN.—In the turtle the anterior lobes of the brain are large, and contain capacious lateral ventricles; in each of them there is a large striated body and a choroid plexus; behind these, and not in the ventricles, there are small thalami joined by a tough commissure; there is also an anterior and posterior commissure; more posteriorly the optic lobes are situated, which have ventricles continuous with the lateral and with that of the cerebellum. There is a pineal gland, and the brain is enveloped in a very dense pia mater. The fourth ventricle extends to the calamus scriptorius, and on its floor there are very prominent ventricular cords. The cerebellum is smooth and round, and has neither lobes nor convolutions; it has a capacious ventricle, so that its parietes are very thin. Its base is very plain, there are no mammillary eminences, and the oblong medulla extends to the spinal cord without much variation in appearance. In the snake the anterior lobes of the brain are of a moderate size, and contain lateral ventricles; in each of them the striated body and an oblong eminence near the middle line are seen, as in the turtle; behind these are the optic lobes, and their inner surface forms the continuations from the lateral ventricles to the calamus scriptorius. The cerebellum is remarkably small and flat; at the base the parts are plain, and similar to those in the turtle. In the frog there are anterior lobes of the brain, and thalami placed externally, optic lobes, and a very diminutive cerebellum, consisting of a narrow transverse band.

CEREBRAL NERVES.—In the turtle the olfactory nerve proceeds from the anterior lobe of the brain; it is composed of coarse fibrils, which preserve this character

even to their termination on the Schneiderian membrane of the nose, and there is not a ganglion. The optic tract proceeds from the optic nerve and thalamus; it joins its fellow in a commissure from which each optic nerve proceeds to terminate in the retina. The third arises in the track of the pyramidal body; it gives a branch to join one from the first trunk of the fifth, to form ciliary nerves, and then gives a branch to the levator, depressor, adductor, and inferior oblique muscles of the eye. The fourth nerve arises from the roof of the ventricle just behind the optic lobes, and terminates in the superior oblique muscle. The fifth arises in the track of the restiform body; it has not a very distinct smaller portion for joining the third trunk, but there is a greater resemblance to the form of the Gasserian ganglion than in fishes: it is divided into three trunks; the first passes forwards, gives a branch to join one from the third nerve for forming ciliary nerves, it then passes underneath the attollent and superior oblique muscles of the eye, gives filaments to the upper eyelid, and enters the nose, where it becomes intimately united with a portion of the olfactory nerve, and divides into several branches, some of which are seen passing upon the Schneiderian membrane, covering the septum, and then, through perforations in the palate, to the surface between the bone and horny covering at the anterior part of the palate and beak. In the snake, it passes forwards first within the cranium, then into the orbit, and gives off a ciliary branch and one to the upper eyelid, and from this part it passes to the Schneiderian membrane, in which it becomes connected with the olfactory nerve, and then terminates on the skin at the end of the nose. In the turtle, the second trunk gives filaments to a muscle of the lower jaw, then passes on the floor of the orbit, gives filaments to the large lachrymal gland and the lower eyelid, and divides into branches, to terminate on the surface of the lower jaw beneath the horny covering. In the snake, after communicating with the sympathetic, it gives filaments to the membrane of the mouth, palate, and nose; it passes out of its canal in the upper jaw, and terminates in branches on the upper lip. In the turtle, the third trunk gives branches to the temporal and other muscles of the lower jaw, and then divides into branches, which terminate on the surface of the lower jaw, beneath the horny covering; it sends two large branches to a portion of muscle analogous to the

mylo-hyoideal, which is connected with and forms the most anterior part of the constrictor muscle of the throat, and resembles the cutaneous in man; it also sends a branch to the membrane lining the mouth. In the snake, it gives branches to the muscles of the jaws; the greatest portion of it then passes within a canal in the lower jaw; it sends three branches through the opening at the inferior margin of this part, two of them to communicate with the branches of the par vagum and ninth distributed on the muscles and parts underneath the jaw, the other to give filaments to the membrane of the mouth, as far as the sheath of the tongue: the trunk is continued onwards through a foramen near the chin, to divide into branches, and terminate in the lower lip. In the turtle, the sixth nerve arises from the oblong medulla in the track of the pyramidal body; it supplies the abductor and the muscles encircling the optic nerve, and spreading over the convex portion of the sclerotic coat of the eye. The hard portion of the seventh arises from the restiform body; it crosses the external auditory meatus, to give filaments to the digastric muscle inserted into the angle of the lower jaw, and then passes to terminate on the constrictor muscle of the throat; it communicates with branches of the cervical nerves given to the lower portion of the same muscle, which are composed of filaments derived from both the anterior and posterior surfaces of the spinal cord. In the snake, it communicates with the ganglion of the sympathetic, and then passes through the digastric muscle, to which it gives a branch; it communicates with the first spinal nerve, and terminates in the costa-maxillary muscle. In the turtle, the auditory nerve arises from the restiform body; it divides into two principal branches; the anterior passes to the termination of the anterior and upright semicircular canals, the other is spread on the sack of the labyrinth, after sending a branch to the termination of the posterior, upright, and the horizontal semicircular canals. The glosso-pharyngeal arises from the restiform body; it passes underneath the sack of the labyrinth, gives filaments to muscles connected with the lingual bone, and terminates on the membrane of the pharynx. In the snake it passes to the superior cervical ganglion of the sympathetic; it communicates with the ninth after its combination with a branch of the par vagum, and terminates on the glottis and the muscles attached to the anterior portion of the jaw for drawing forward

the trachea. In the turtle, the par vagum arises from the restiform body, and sends a filament to communicate with the auditory nerve in the sack of the labyrinth; it sends off the laryngeal nerve to the larynx, and small branches to the pharynx and œsophagus: at the bottom of the neck it leaves the sympathetic nerve, with which it passes in close coalition after its exit from the cranium; it then gives off the recurrent branches to wind round each aorta to the œsophagus and trachea; it sends a branch on each side to the ventricles of the heart, and others along the large vessels to the auricles, and many branches to each lung and the stomach. In the snake, it communicates with the sympathetic, and then with a branch that appears to be the continuation of the glosso-pharyngeal from the ganglion of the sympathetic; it sends a branch to communicate with the ninth to pass to the muscles of the fauces, and is then continued downwards close to the trachea in company with each jugular vein; on the left side it also accompanies the carotid artery, and from this a small vessel ascends with the right trunk; it sends filaments on the large vessels towards the heart, and others behind each aorta, similar to the recurrent nerves, to be distributed on the trachea and œsophagus; each trunk for a short space accompanies its corresponding pulmonary artery; a little above the liver it passes in front of the superior part of the lungs, and proceeds a short distance, where it is joined by its fellow to form a single nerve; this is continued downwards under a thick membrane on the liver, and appears to give filaments to this viscus, the lungs, and œsophagus; about the termination of the liver it sends a large branch, which has communicated freely with branches of the sympathetic, to the left surface of the stomach; this gives filaments to the lowest part of the lungs, and terminates in the stomach. The right division, or the continuation of the nerve itself, having communicated several times with the left division and filaments from the plexus of the sympathetic, is continued a short way on the membrane connecting the viscera; it passes on the right surface of the stomach, distributing branches to this viscus, and terminates in the beginning of the intestines, reaching as far as the pancreas. In the turtle, the accessory nerve arises from the posterior part of the spinal cord, without joining any of the posterior bundles of cervical nerves; it passes out with the par vagum, and, after the junction

of this with the ninth, appears as if it were proceeding from the ninth to give branches to a long muscle analogous to the sterno-mastoid, and then send a branch to join one from the first and second cervical nerves, and terminate in the sterno-thyroideal muscle, one attached to the posterior part of the œsophagus, and one at the side of the neck. The ninth arises from the track of the pyramidal body, and divides into an anterior and posterior trunk; the anterior becomes connected with the par vagum and accessory; the anterior terminates on the genio-hyoideal muscle, the genio-glossal, and the hyo-glossal, after sending one, which may be the accessory, to terminate on the sterno-thyroideal muscle, and that attached to the posterior surface of the œsophagus; the posterior trunk joins the posterior trunk of the first cervical nerve. In the snake, it receives a branch from the trunk of the par vagum and from the hard portion of the seventh, after this has communicated with the first cervical nerve; it gives several branches to the muscles of the tongue and throat, and one that reaches to the end of the tongue, and one to communicate with branches of the third trunk of the fifth issuing from the inferior part of the lower jaw.

SPINAL CORD.—The spinal cord in the turtle is continued from the oblong medulla to the end of the tail; it is somewhat flattened, and is larger in the regions giving off the largest nerves. In the turtle, the first two cervical nerves are formed entirely of filaments from the anterior surface of the cord. The anterior bundles of all the other cervical nerves are much larger than the posterior, those of the thoracic smaller, and those of the sacral rather larger. Each posterior bundle is formed into a ganglion, and is joined by the anterior for forming a nerve. In the crocodile, the spinal cord reaches to the extremity of the tail, and each posterior bundle of fibrils forms a ganglion. In the snake, it is continued of nearly the same thickness throughout until it reaches the tail, and it is then extended to the end of the tail by becoming gradually smaller. The cineritious matter contained within it appears very full of vessels after its minute injection with colouring matter. The cord gives off anterior and posterior bundles of nerves, which are very close to each other, and the anterior are rather larger than the posterior; the posterior is formed into a ganglion, and at its anterior point the anterior bundle becomes connected with it for the completion of

each spinal nerve. In the frog, the spinal cord is very short, the nerves of the lower extremities form a long cauda equina; there are anterior and posterior bundles of nerves, each posterior bundle forms a ganglion.

SPINAL NERVES.—In the turtle, the first two cervical nerves, when derived entirely from the anterior bundles, are altogether given to the muscles; but when the second has a filament from the posterior, a portion of it is likewise given to the skin. The two first, nevertheless, have anterior and posterior trunks like the rest. The anterior trunk of the first gives filaments to the cervical muscles, and joins a branch of the ninth, and then gives filaments to the outside of the carotid artery, and terminates in the sterno-thyroid muscles, and one attached to the back of the œsophagus; the posterior trunk communicates with the posterior branch of the ninth, and terminates entirely in the muscles at the back of the neck. The anterior trunk of the second passes to a long muscle at the anterior part of the neck, and the posterior to others on the posterior. A branch from the third cervical nerve may be traced through a portion of muscle to the skin of the face, and one from each of those below to the skin of the neck; the third and fourth also give branches to the muscles of the neck. The fifth, sixth, seventh, and first dorsal form the axillary plexus for supplying the skin and muscles of the anterior extremity, and resemble most the median, spiral, and circumflex. The median descends and divides into large branches, which pass into the substance of the hand, and give branches to the tendinous and muscular parts, and send others towards the skin in the form of digital nerves. The spiral gives some muscular branches in its course, and passes round to the outer side of the arm-bone, and divides and sends a branch through the outer condyle to join another, which is the principal continuation of the nerve, to terminate on the skin at the outer margin and back of the hand. The circumflex passes upwards, beneath the muscle resembling the broadest of the back, and gives a branch to the larger teres muscle, and is then directed downwards, to terminate on the skin at the back of the arm. Most of the nerves of the dorsal region enter principally into the structure of the great shell; the rest of the dorsal and sacral and caudal supply the posterior extremity, the tail, and the reproductive organs externally. From the ninth dorsal

nerve and the tenth, the nerves representing the anterior crural, obturator, and other nerves usually proceeding from the lumbar, are given off; these are distributed on the muscles and skin connected with the superior part of the pelvis and thigh. The sciatic nerve is principally formed by the eleventh dorsal and first sacral nerves; it divides into two principal parts, one of which gives branches to the muscles of the thigh, and is continued on the under surface of the foot, and terminates on the skin, like digital nerves; the other, after giving off some muscular branches, passes to the skin and other structures on the upper surface of the foot. In the snake, the spinal cord begins at the termination of the oblong medulla; it is continued quite to the end of the tail; it is of nearly the same size throughout to this part, and then becomes gradually smaller; it has cineritious matter within it. It gives off anterior and posterior bundles of nerves; their roots are very close to each other, and the anterior is rather larger than the posterior; at the anterior point the anterior bundle becomes connected with it; after this union, it sends a posterior branch backwards to the muscles and skin; the anterior proceeds forward to some distance between two ribs, and sends branches between them to the exterior of the body, and then is continued over the inner surface of the anterior portion of two ribs, to terminate on the anterior part of the body. In the frog there is one large nerve, instead of the axillary plexus. The nerves of the cauda equina terminate in the anterior crural and sciatic for the lower extremity.

SYMPATHETIC NERVE.—In the turtle, testudo mydas, the sympathetic is very closely connected with the par vagum, but in the testudo imbricata it is more separate. There is not any appearance of a superior cervical ganglion: from the upper part of the trunk one branch passes forwards along with one of the divisions of the carotid artery, in a canal at the base of the skull, gives a filament to the hard portion of the seventh, and communicates with a branch of the second trunk of the fifth, which terminates on the posterior part of the palate. Another branch passes with the other division of the carotid artery into the reticular sinus, close to the external auditory meatus, and communicates with the ninth, par vagum, glosso-pharyngeal, and the hard portion of the seventh. It passes down, in connexion with

the par vagum, to the first thoracic ganglion; it sends up branches to communicate with the cervical nerves: those at the upper part of the neck are delicate, and not easily traced: they do not enter a canal with a vertebral artery, as in mammalia and birds, but pass on the outside of the spine; it communicates with the nerves about to form the axillary plexus, also with the trunk of the par vagum, and sends many filaments on the arteries. The prolongation from it through the thorax communicates or coalesces with the ganglia of the dorsal nerves, but the anterior branch of each intercostal artery passes through or is embraced by this union. The prolongation frequently consists of a thick branch, and a very fine one, and passes down to each succeeding ganglion; but neither of them passes behind the neck of each rib, as in birds. It gives many small branches to the connecting membrane of the viscera, but the principal branches of each side form two intricate plexuses, which are in the place of semilunar ganglia; the superior or smaller portion follows the branches of the cœliac artery to the stomach, the lower or larger, the branches of the mesenteric artery to the intestines. Other branches pass from the sympathetic to the kidney, and the spinal nerves keep sending filaments towards this part, which seems to be the situation of the prolongation; and it is continued down to the side of the rectum, communicating with all the spinal nerves, until their extreme minuteness prevents their further continuation from being easily followed. In the snake, the sympathetic has a superior cervical ganglion situated near to, and connected with, the trunk of the par vagum. It communicates with the hard portion and sends upwards a branch some way in a canal at the base of the cranium, which forms a small ganglion with a branch of the second trunk of the fifth, and sends filaments to the membrane covering the posterior part of the mouth and palate: one of these communicates again with the second trunk of the fifth before its termination; this ganglion then sends another branch forward to form another ganglionic union with a branch of the second trunk of the fifth, and from this a branch is sent to the posterior part of the nose to ramify on the Schneiderian membrane: other branches are given to the membrane covering the mouth and palate; one passes forward, and communicates again with a branch of the second trunk of the fifth, and is distributed on the membrane covering the

anterior part of the mouth and palate. The prolongation communicates with the ninth nerve; it passes down the spine and communicates with the eleven superior spinal nerves; it emerges on each side at the place the superior branches of the vertebral artery enter to distribute branches in the intercostal spaces; it is continued downwards in a very fine plexiform prolongation with the vertebral artery, as far as the origin from the right aorta; it then branches to each side beneath the membrane connecting the viscera with the ribs and spine, and communicates with filaments of the par vagum; it is afterwards continued downwards, receiving a filament from each spinal nerve. In its course it is a very fine nerve, and has not any more ganglia than the first, and those communicating with the second trunk of the fifth; but at different points, from which the nerves pass to the viscera, there is an appearance of a delicate plexus: this plexiform structure varies in different parts, and becomes much greater about the beginning of the intestine, where it resembles that corresponding with the semilunar ganglion in the turtle; near the kidney it assumes the form of a nervous membrane or retina before it is distributed on the urinary and generative organs. Branches pass from the plexuses with the arteries to the different viscera. In the frog, there is a ganglion connected with the upper part of the par vagum; it sends a branch upwards to communicate with the branch of the fifth passing to the palate; the prolongation downwards is formed from branches of the spinal nerves, which communicate with each other before they terminate on the viscera. In the crocodile, the sympathetic nerve is continued down the neck, in a canal like that of the vertebral artery in birds, and then underneath a process from the head of each of the three superior ribs; it is continued in the thorax double from one ganglion to another. The branches of the sympathetic form a plexus instead of a semilunar ganglion, from which branches proceed to the stomach, liver, and intestines. Branches then pass to the ovary and kidney, and appear to have a disposition between that in the turtle and snake; the sympathetic passes down and forms a junction with that of the opposite side on the caudal artery, along which it is continued into the tail, nearly as in the calf and porpoise. The ganglia throughout the sympathetic are not distinct.

In an alligator six feet long, there is a small prolongation descending on the

surface of the anterior cervical muscles; it communicates at the upper part of the neck with the cord in the usual canal of the vertebral artery, and then passes to join the cœliac plexus. There is a continuation of the sympathetic having numerous ganglia in the usual canal of the vertebral artery. The ganglia do not adhere to the spinal nerves as in birds, but send branches to them: they are not so large in proportion to the spinal nerves as in birds. There are ganglia in the thoracic and lumbar portions; and the thoracic adhere very much to the spinal nerves. A strong branch from the first thoracic ganglion, which corresponds with the lowest nerve entering the axillary plexus, accompanies the right portion of the vein corresponding with the superior cava, which is not in one trunk, but the subclavian and jugular of each side form a separate one, which enters at the bottom of the pericardium; it becomes mixed with branches of the par vagum, and thus corresponds in some degree with the cardiac nerves in birds; but the heart has also a large supply from the par vagum, the branches of which ramify considerably on the pericardium before they pierce it for reaching the heart. The nerves pass behind and on the pericardium, to which they adhere so firmly as to be with difficulty separated in their progress to the heart. There is a large plexus formed from the superior thoracic ganglia for the liver. Branches, proceeding from several thoracic ganglia, form a plexus about the renal capsule, instead of a semilunar ganglion, and from this and the other lumbar portion branches are given to the ovary and oviduct, also to the intestines. There is more membrane in the plexus than in the turtle, and the branches are finer and softer, so that although it approaches nearer, it does not reach to the state of a fleshy, or close semilunar ganglion, and does not form so uniform a membranous surface as in the porpoise, pig, and others, in which there is much membrane and not much of the close fleshy ganglionic structure.

The brain of amphibia differs from that of fishes externally, in the size and shape of several parts. In the larger size of the anterior lobes, in which there is a capacious ventricle, a prominence in this that may be compared with the striated body and a choroid plexus, in not having any mammillary eminences. In having small thalami, connected together in the turtle by a very tenacious commissure, but not placed as in

mammalia with respect to the lateral ventricles, but behind these and out of the cavities, and their situation is even more remarkable in the frog. In having posterior as well as anterior commissures, the anterior alone existing in some fishes. The ventricle in the optic lobe is very similar; but in the floor of this, the longitudinal bands extending towards the calamus scriptorius are more prominent. It differs in the very dense membrane covering it, especially in the turtle, in not having so much space in the skull, and not being placed in a fine reticulated membrane containing fluid. In having a pineal gland as well as pituitary one. The cerebellum differs from that of fishes in its roundness, and thinness of its parietes, and the greater capacity of its ventricle.

In the snake, the brain is nearly the same as in the turtle; and there is not much difference in the frog, except that the thalami appear externally. In the snake and frog the cerebellum is so small, as hardly to bear a comparison with that of the turtle or fishes.

In amphibia the nerves are firmer than in fishes, and acquire much magnitude from the addition of neurilema. In the snake, those about the throat are not only tortuous, but in a considerable degree elastic, and thus allow of being sufficiently extended in deglutition. They are large in comparison with the whole brain, but accord with the size of the oblong and spinal medulla, as in fishes. In the turtle and snake, the olfactory nerves have not distinct ganglia: after being joined by the first trunk of the fifth, they are distributed in coarse branches on the Schneiderian membrane, and appear similar; but it may be remarked, that their structure corresponds very much with that of the splanchnic plexuses, which have not ganglia intermixed with, or giving immediate origin to, them. The origin of the optic nerves is from the optic lobes and thalami, and not from the optic lobes and mammillary eminences, as in fishes. In the other nerves of the orbit there is not any particular change, except that the sixth is larger, and supplies the additional muscles, which do not exist in fishes; and in the turtle the ciliary nerves proceed from a junction of branches from the third and fifth nerves, but this has not the form of a ganglion. The fifth has not a very distinct smaller portion for joining the third trunk, but there is a greater

resemblance to the form of the Gasserian ganglion than in fishes; the usual cutaneous branches pass through perforations in the bone to the parts beneath the horny covering in the turtle, but this disposition does not exist in the same degree in the snake, and is therefore a peculiarity for corresponding with the conformation of the parts receiving them. The par vagum and glosso-pharyngeal at their origins are not very different from the same in fishes, except that they are not so much connected with the auditory nerve. In the snake, so many communications between the glosso-pharyngeal, par vagum, and ninth, take place before branches are given off to supply any parts, that it is very difficult to determine with precision the destination of each, for the muscles and other structures of the throat are so complicated, and at the same time so connected in function, that although the nerves be different at their origins, yet it seems they must be connected for associating the actions of the parts receiving them. In amphibia the par vagum appears to supply almost entirely the heart. When the slight difference between the summit and base of the brain in the turtle and skate is considered, it cannot fail of being remarked that so many more nerves exist in the turtle than in the skate, as the hard portion of the seventh, a more distinct auditory nerve, the ninth and accessory; but the changes attendant on respiration by lungs require more ample provisions in several parts for their completion.

There is not much difference between the spinal cord of amphibia and fishes, for in both classes it varies with the length and thickness of the body. In the turtle it is flat, and somewhat broader, for giving origin to the nerves of the upper and lower extremities. In the snake it preserves nearly the same thickness throughout, until it reaches towards the tail. In numerous fishes it is thick at the upper part, and gradually diminishes in descending by tapering to the end of the tail; in longer or shorter kinds it varies according to the quantity of nerves required to issue from it. The spinal nerves of amphibia are not very different from those of fishes, except in the closeness of their origins, especially in the snake, and the more regular communications of the anterior and posterior bundles of each nerve, and having more distinct and fleshy ganglia. In the frog there is one large nerve instead of a number forming the axillary plexus, as in the turtle; in both, however, there is a plexus

resembling that in the higher classes for giving off the nerves of the posterior extremities, for the spinal nerves, entering it, correspond with these, inasmuch as they have their origin from the inferior part of the spinal cord, just above that from which the caudal nerves usually issue.

In the sympathetic nerve there are several varieties in different genera of amphibia. In the crocodile and alligator the sympathetic nerve is continued down the neck in a canal like that containing the vertebral artery in birds. In the turtle and snake, there is not a canal in which the sympathetic passes with a vertebral artery; the branch, according with the one ascending from the first thoracic ganglion in mammalia, passes on the outside of the spine in the turtle, and in the snake, in an incomplete canal near the connexion of the ribs with the eleven superior vertebræ. In the turtle, there is a prolongation, but no cervical ganglia; it is more or less closely attached to the par vagum, but does not exist in the snake, or, if it does, its small size prevents its being easily recognised and distinctly separated. The sympathetic does not appear to be more highly evolved than in fishes; for in the turtle, the ganglia attached to the prolongation are very diminutive, except the first thoracic, which is broad, and has a membranous character; and in the snake, except at its superior part, where there is one remarkable ganglion connected with the trunk of the par vagum, and several smaller ones at the junction of the sympathetic with branches of the second trunk of the fifth proceeding to the palate and nose; in the snake for some distance there are very slight plexiform junctions of the branches from the spinal nerves which join the prolongation; but these plexuses are in some parts more complicated, and in both the snake and turtle exist for giving off the nerves to the viscera instead of the close and fleshy semilunar ganglia. In the frog as in the snake, except the first cervical, no other distinct ganglia of the sympathetic exist, and the branches destined for the abdominal viscera also join a prolongation from which the splanchnic branches are derived.

The brain of amphibia, compared with that of fishes, is rather more complicated. It has to sustain respiratory processes through capacious lungs; and these acts are so forcible in the turtle, as to seem to be promoted more by a voluntary than an

involuntary effort. For any other purposes the simple voluntary centres supplied by the small brain suffice, as in fishes. With the lungs there is the first appearance of a striated body and the choroid plexus. In both these classes the oblong medulla bears a greater proportion to the size of the brain than in the higher, and seems to be equally connected with the animal functions, and the lobes of the brain, as in them, to be varied and superadded according to the required voluntary and other faculties. The large size of the spinal cord, as compared with that of the brain, is also very remarkable. When, therefore, the vast intricacy and number of the organs of the body in both these classes are considered, and that they are nearly as great as in the two higher classes, and when it is observed how small the size of the brain is in proportion to the nerves, it must be concluded that both the oblong and spinal medulla have peculiar and important functions; as the nerves bear no proportion to the size of the brain, but only to that of the oblong and spinal medulla, it must also be concluded that their power is principally derived from these parts.

Fig. 1

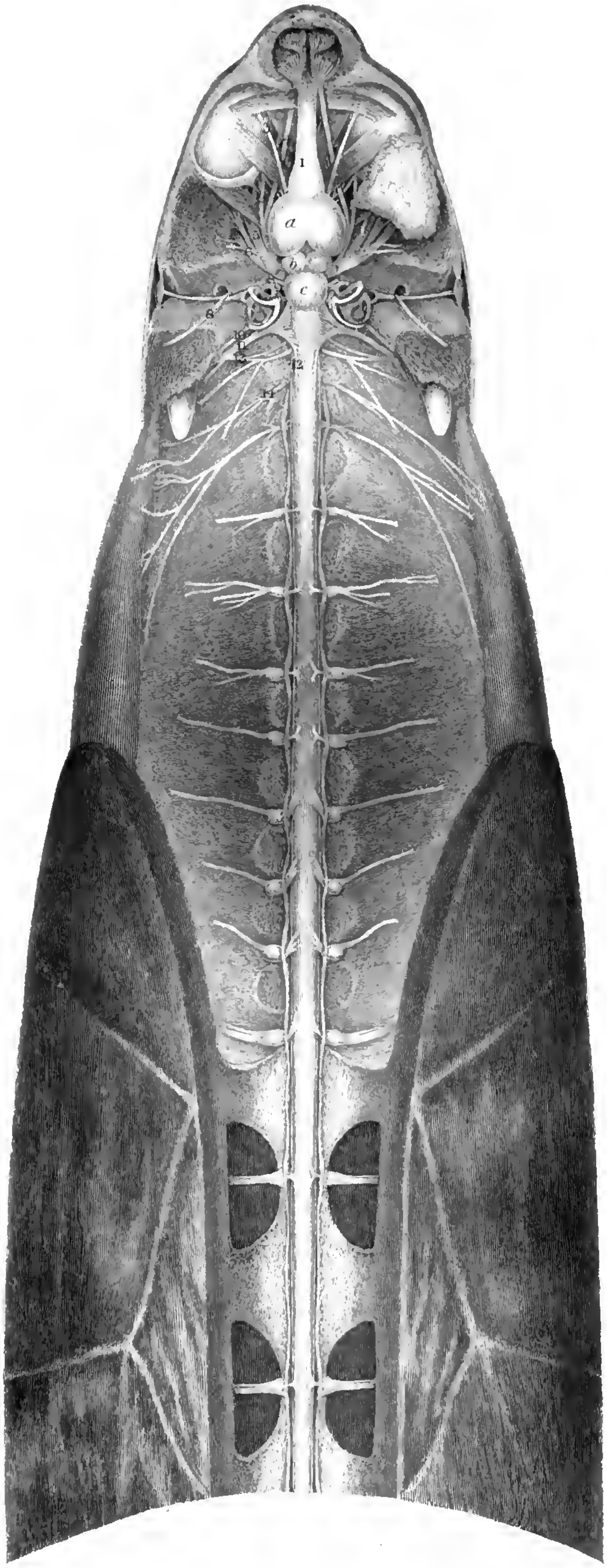

Fig. 2

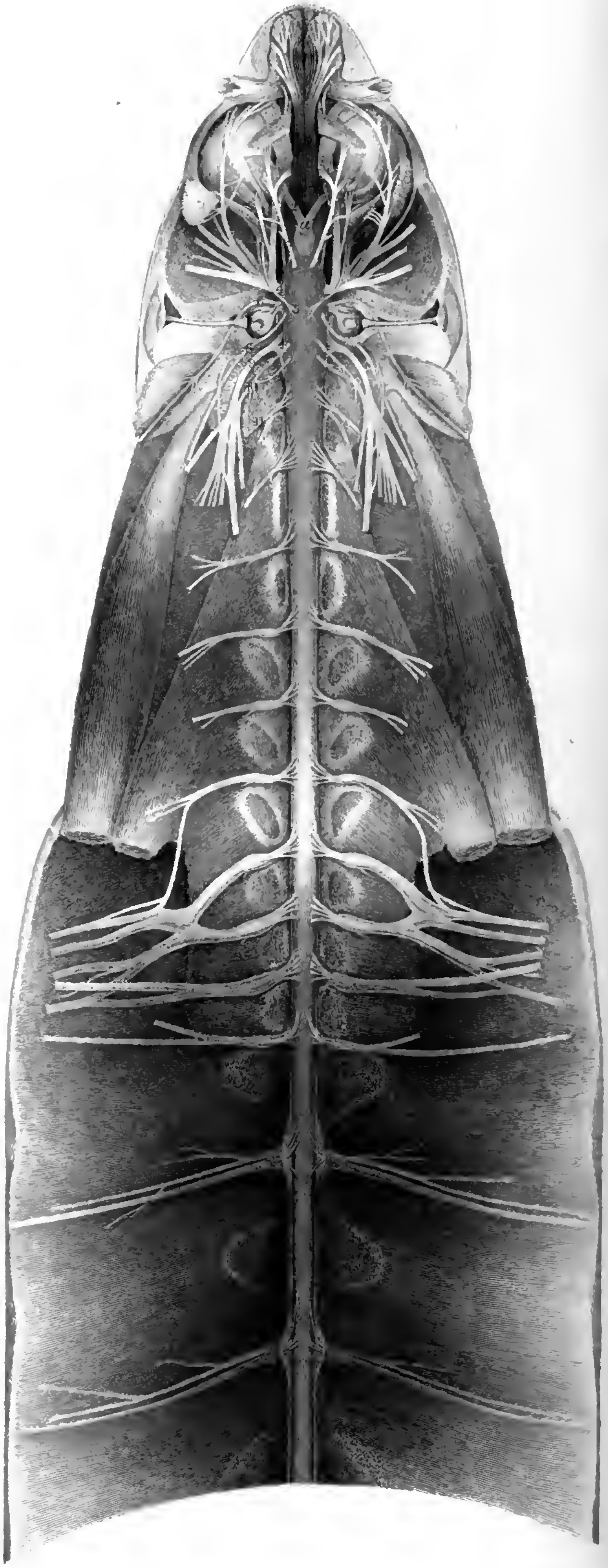

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Fig. 1

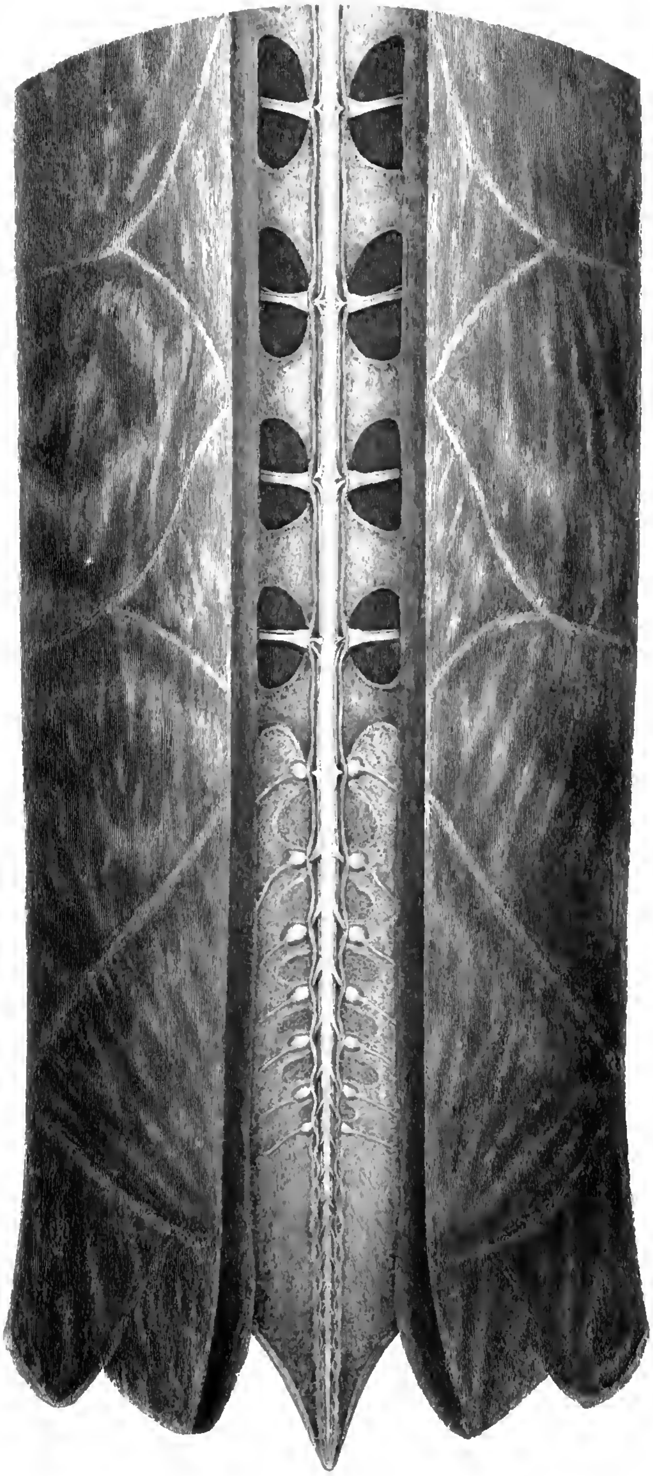
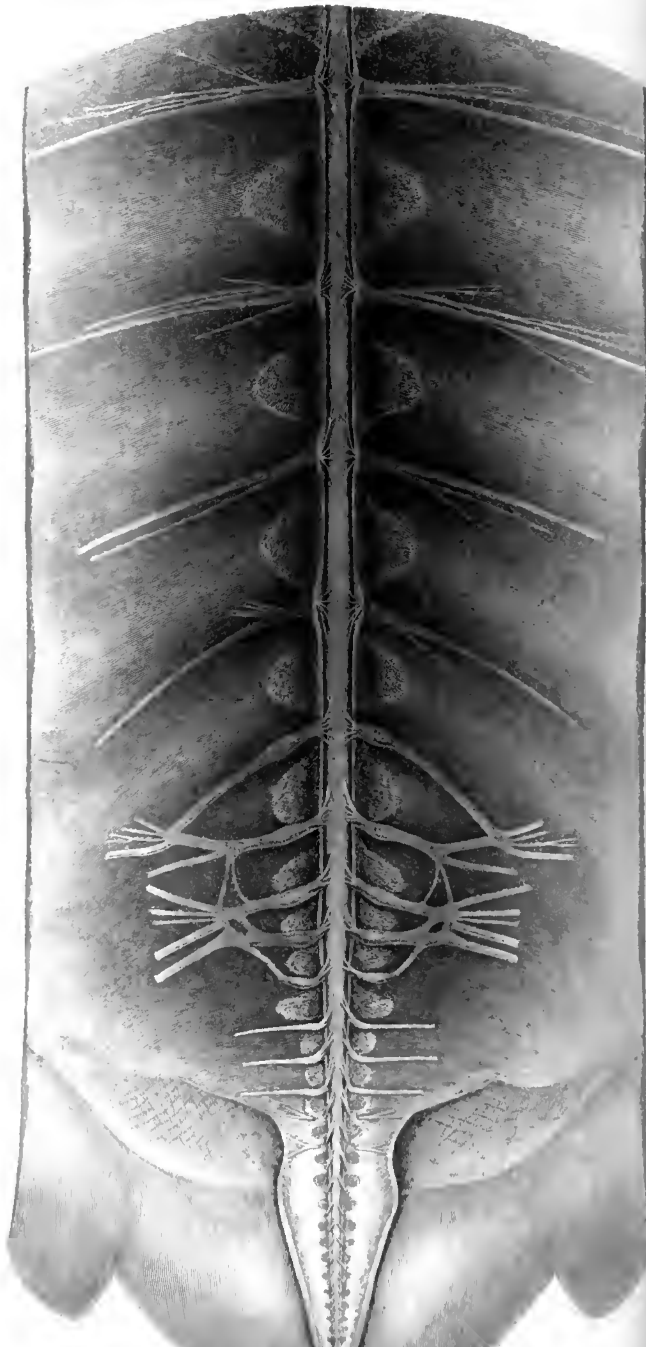


Fig. 2



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PLATES XII.—XIII.

THE BRAIN AND SPINAL CORD OF THE TURTLE.

(TESTUDO MYDAS.)

FIG. I.

DORSAL ASPECT.

THIS figure, and the first in the next plate, exhibit the summit of the brain and the posterior surface of the spinal cord.

a. Anterior lobes of the brain.

b. Optic or posterior lobes of the brain.

c. Cerebellum.

In the spinal cord there are not any posterior bundles to join the anterior of the two first cervical nerves. All the posterior bundles of the cervical nerves are seen much smaller than the anterior, those of the thoracic larger, and those of the sacral rather less.

1. Olfactory nerve continued from the anterior point of the anterior lobe, and passing to the nose, but not forming a ganglion, and terminating in coarse brushes on the Schneiderian membrane.

2. A branch of the first trunk of the fifth, joined by one from the third, to form ciliary nerves.
3. Fourth, or pathetic nerve, arising from the roof of the ventricle just behind the optic lobes, and passing to terminate in the superior oblique muscle of the eye.
4. First trunk of the fifth; it passes forward, gives a branch to join one from the third nerve to form the ciliary nerves, passes underneath the attollent and superior oblique muscles of the eye, gives filaments to the upper eye-lid, and then enters the nose, where it becomes intimately united with a portion of the olfactory nerve, and terminates on the Schneiderian membrane.
5. Second trunk of the fifth; it gives filaments to a muscle of the lower jaw, then passes on the floor of the orbit, gives filaments to the large lachrymal gland and the lower eye-lid, and divides into branches to terminate on the surface of the palate and upper jaw beneath the horny covering.
6. Third trunk of the fifth; it gives branches to the muscles of the lower jaw, and then divides into branches, which terminate on the surface of the lower jaw beneath the horny covering.
7. A branch of the sixth nerve, given to the muscles which encircle the optic nerve, and are spread on the convex portion of the sclerotic coat.
8. Hard portion of the seventh nerve.
9. Auditory nerve.
10. Glosso-pharyngeal nerve.
11. Trunk of the par vagum.
12. Accessory nerve arising from the posterior surface of the spinal cord without joining any of the posterior bundles of the cervical nerves.
13. Ninth nerve.
14. First cervical nerve.

Fig. II.

VENTRAL ASPECT.

This figure, and the second in the next plate, exhibit the base of the brain, and the anterior surface of the spinal cord.

a. Commissure of the optic nerves, and the connection with the part in the situation of the mammillary eminences. The pituitary gland has been removed.

The base of the brain is very smooth, and covered with a thick pia mater; so that the separation at the usual places of the several eminences is not distinctly observed before this is removed.

The anterior bundles of the nerves of the cervical portion of the spinal cord are much larger than the posterior; those of the thoracic much smaller; and those of the sacral rather larger. The first two cervical nerves are formed entirely of filaments from the anterior surface; the anterior trunk of the first gives filaments to the cervical muscles, and joins a branch of the ninth, and then gives filaments to the outside of the carotid artery, and terminates in the sterno-thyroid muscle, and one attached to the back of the œsophagus; the posterior trunk communicates with the posterior branch of the ninth, and terminates entirely in the muscles at the back of the neck; the anterior trunk of the second passes to a long muscle on the anterior part of the neck, and the posterior to others on the posterior. Sometimes only the first cervical nerve is formed entirely from filaments of the anterior surface of the spinal cord, and then the second has a filament from the posterior surface, and gives the branch to the skin of the face, instead of the third. A branch from the third cervical nerve may be traced through a portion of muscle to the skin of the face, and one from each of those below it to the skin of the neck.

1. Olfactory nerve.
2. Optic nerve.
3. Third or common oculo-muscular nerve, arising behind the mammillary eminence in the track of the pyramidal body; it gives a branch to join one from the first trunk of the fifth to form ciliary nerves, and then gives a branch to the levator, depressor, adductor, and inferior oblique muscles of the eye.
4. Fifth or trigeminal nerve, arising in the track of the restiform body.
5. Sixth nerve given to the abducent muscle, and those which encircle the optic nerve, and are spread on the convex portion of the sclerotic coat of the eye.
6. Hard portion of the seventh, arising from the restiform body; it crosses the external auditory meatus to give filaments to a muscle inserted into the angle of the jaw, and then passes to terminate on the constrictor muscle of the throat, which resembles in some degree the cutaneous muscle in the human subject; it communicates with branches of the cervical nerves given to the lower portion of the same muscle, and these are composed of filaments derived from both the anterior and posterior surfaces of the spinal cord.
7. Auditory nerve, arising from the restiform body; it divides into two principal branches: the anterior passes to the termination of the anterior upright and horizontal semicircular canals; the other is spread on the sack of the labyrinth, after sending a branch to the termination of the posterior upright and the horizontal semicircular canals.
8. Glosso-pharyngeal nerve, arising from the restiform body; it passes underneath the cavity containing the sack of the labyrinth, gives filaments to muscles connected with the lingual bone, and terminates in the membrane of the pharynx.
9. Trunk of the par vagum, arising from the restiform body, and sending a filament to communicate with the auditory nerve on the sack of the labyrinth.
10. Ninth or hypo-glossal nerve, arising near the situation of the pyramidal bodies by two or three roots; it divides into an anterior and posterior trunk: the

anterior terminates on the muscles connected with the lingual bone, after sending a branch to join one from the first cervical nerve, to terminate on the sterno-thyroid muscle and that attached to the posterior surface of the œsophagus; the posterior branch joins the posterior branch of the first cervical nerve.

11. First cervical nerve.

PLATE XIV.

THE TURTLE.

(TESTUDO MYDAS.)

Fig. I.

1. Branches of the olfactory nerve are seen distributed on the Schneiderian membrane, covering the septum of the nose.
2. First trunk of the fifth connected with the olfactory nerve; it becomes divided into several branches, some of which are seen passing on the anterior part of the Schneiderian membrane, and then through portions of bone, to terminate beneath the horny and membranous coverings of the anterior part of the nose; the others are seen passing upon the Schneiderian membrane covering the septum, and then through perforations in the palate to the surface between the bone and horny covering at the anterior part of the palate and beak.

Fig. 1.

Fig. 2.

Fig. 3.

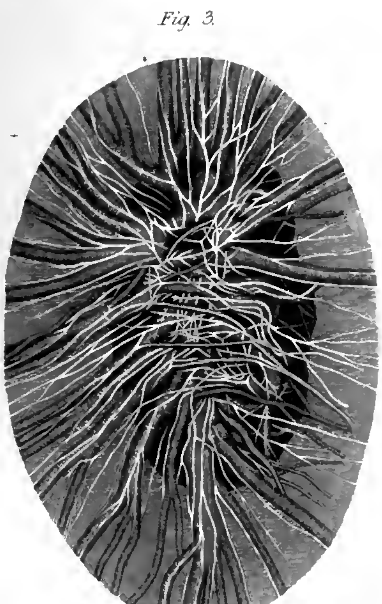

Fig. 4

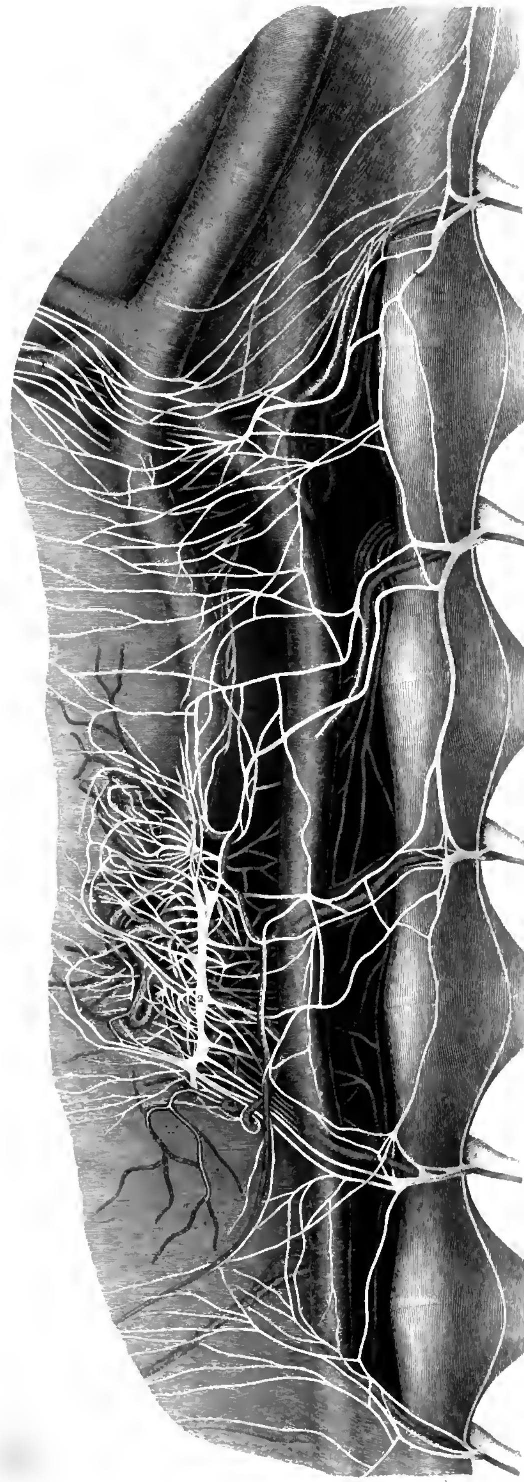

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Fig. II.

(THE SAME.)

When the third trunk of the fifth has entered the jaw, it is seen distributing branches on a membrane investing a cartilage situated within the lower jaw, and then giving off filaments to the parts beneath the horny covering: and sending two large branches to a portion of muscle analogous to the mylo-hyoideal, which is connected with and forms the most anterior part of the constrictor muscle of the throat, and resembles the cutaneous muscle in man it is seen sending a branch also to the membrane of the mouth.

It is probable that the connexion of the nerves with the membrane, and the position of this on the cartilage within the jaw, produce a peculiar and necessary degree of feeling, and at the same time prevent shocks which would otherwise be experienced in the forcible adaptation of the hard and horny jaws.

Fig. III.

(THE SAME.)

This figure represents the branches of the splanchnic nerves in their passage, with the branches of the mesenteric artery on the mesentery towards the intestines.

Fig. IV.

(THE SAME.)

This figure represents the sympathetic nerve of the left side, and its termination in the visceral nerves.

1. Branches from each side of the dorsal ganglia of the sympathetic and the prolongation, to accompany the branches of the cœliac artery to the stomach.
2. A large and intricate plexus in the place of the semilunar ganglion; it sends branches to communicate with the renal plexus, and then gives off numerous filaments to accompany, for the most part, the branches of the mesenteric artery to the mesentery and intestines.

PLATE XV

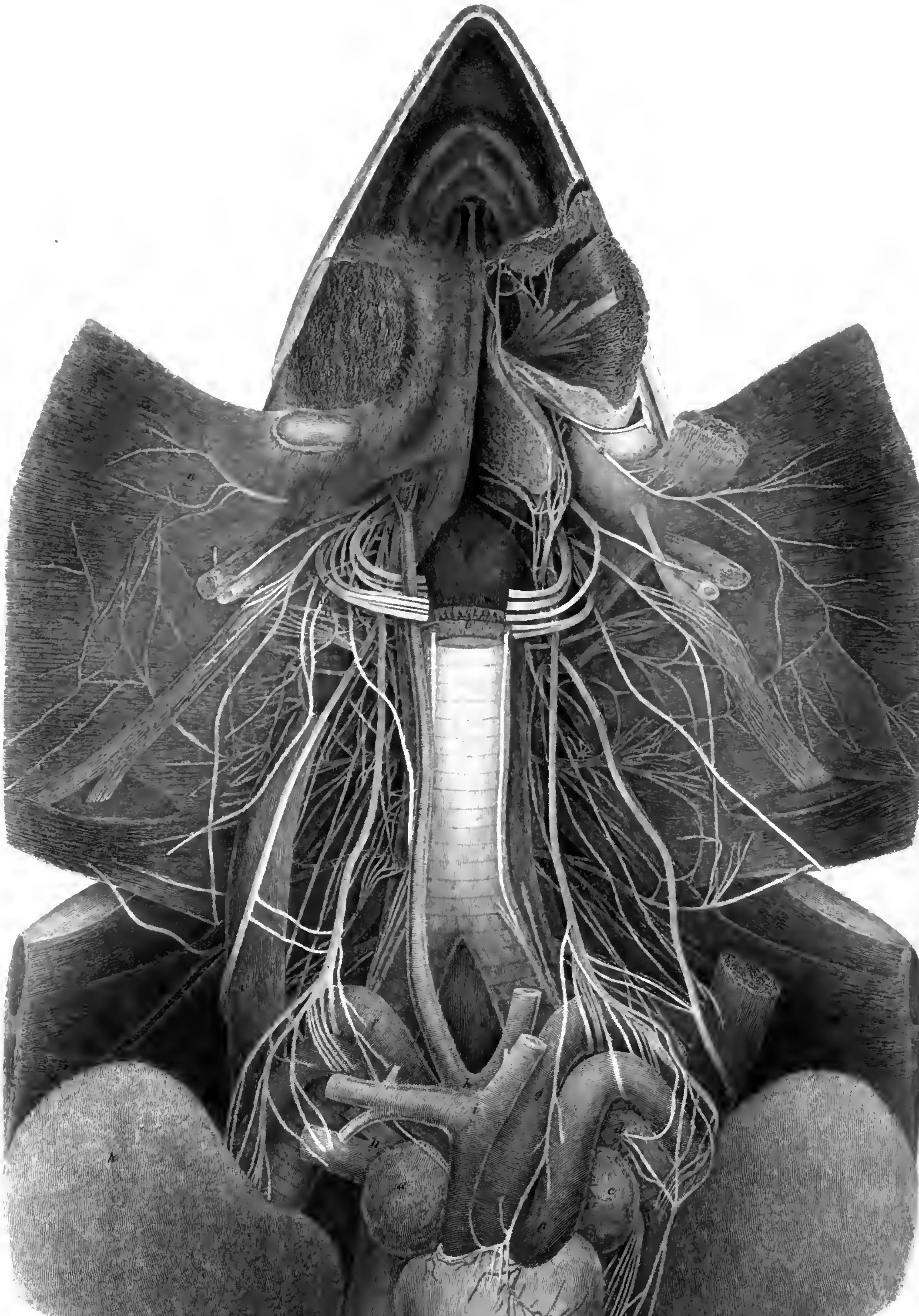

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PLATE XV.

THE SYMPATHETIC NERVE OF THE TURTLE.

(TESTUDO IMBRICATA.)

IN this subject, the sympathetic nerve of each side formed a distinct trunk, but communicated with that of the par vagum by branches. From its upper part, one branch passed forward along with one of the divisions of the carotid artery in a canal at the base of the skull, gave a filament to the hard portion of the seventh, and communicated with a branch of the second trunk of the fifth, which terminated on the posterior part of the palate.. Another branch passed, with the other division of the carotid artery, into the reticular sinus, close to the external auditory meatus, and communicated with the ninth, the par vagum, the glosso-pharyngeal, and the hard portion of the seventh.

The trunk of the sympathetic nerve in this subject is very similar to that of the par vagum, except that it has a somewhat more red and close appearance at its superior part, and near the first thoracic ganglion. The branches belonging to the sympathetic, and those belonging to the par vagum, could be more clearly determined than in the Testudo Mydas, which has both these nerves generally coalescing.

a. Right auricle; *b.* Veins returning blood to the right auricle; *c.* Left auricle; *d.* Left pulmonary vein, the right has been removed; *e.* Pulmonary artery; *f.* Right aorta; *g.* Left aorta; *h.* Division of the carotid arteries; *i.* Division

of the subclavian arteries; *k.* Lungs; *l.* Œsophagus; *m.* Stomach; *n.* Constrictor muscle of the throat, corresponding with the cutaneous muscle in man.

1. Second trunk of the fifth nerve.
2. Hard portion of the seventh joining branches of the cervical nerves.
3. Glosso-pharyngeal nerve, giving a branch to the hyo-maxillary muscle.
4. Par vagum.
5. Laryngeal branch of the par vagum.
6. Recurrent nerves of the par vagum.
7. Ninth nerve.
8. Sympathetic nerve.
9. A long branch from the thoracic ganglion of the sympathetic passing up the neck, giving filaments to the surrounding parts, and communicating with the five superior cervical nerves, and again with the sympathetic, just before the entrance of this into the head.
10. First cervical nerve.
11. Second cervical nerve.

PLATE XV

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PLATE XVI.

A GENERAL VIEW OF THE NERVES OF THE TURTLE.

(TESTUDO MYDAS.)

On the right side, the bones and muscles of the shoulder and pelvis have been almost altogether removed for allowing a view of the nerves.

1. Hard portion of the seventh nerve.
2. Trunk of the par vagum; on each side it sends a large branch to the larynx, and smaller branches to the pharynx and œsophagus; at the bottom of the neck, it leaves the sympathetic nerve; it then gives off recurrent branches to wind round each aorta to the œsophagus and trachea; it sends a branch on each side to the ventricles of the heart, and others along the large vessels towards the auricles; and many branches to each lung and the stomach.
3. Laryngeal branch from the right trunk of the par vagum; it gives branches to the muscles of the glottis, the membrane covering this, and to the œsophagus; also one distributing filaments on the carotid artery and surrounding parts, and then rejoining the trunk of the par vagum.
4. Recurrent branches of the right trunk of the par vagum to the trachea and œsophagus.
5. Glosso-pharyngeal nerve; it gives a branch to the hyo-maxillary muscle arising from the lower jaw, and inserted into the posterior cornu of the

hyoid bone, and the side of the pharynx, and then terminates on the membrane of the fauces covering the pharynx and tongue.

6. Anterior trunk of the ninth nerve; it gives branches to the genio-hyoideal muscle, the genio-glossal, and the hyo-glossal.

7. A nerve from the ninth, giving branches to a long muscle analogous to the sterno-mastoid, and then sending a branch to join one from the first and and second cervical nerves, and terminate on the sterno-thyroideal muscle, one attached to the posterior surface of the œsophagus, and one at the side of the neck.

8. Sympathetic nerve passing to the first thoracic ganglion; it sends up branches to communicate with the cervical nerves; those at the upper part of the neck are delicate and traced with difficulty, they do not enter a canal with a vertebral artery, as in mammalia and birds, but pass on the outside of the spine; it communicates with the nerves about to form the axillary plexus, also with the trunk of the par vagum, and sends many filaments on the arteries. The prolongation from it through the thorax communicates or coalesces with the ganglia of the dorsal nerves, but the anterior branch of each intercostal artery passes through or is embraced by this union. The prolongation frequently consists of a thick branch and a very fine one, and passes down to each succeeding ganglion, but neither of them passes behind the neck of each rib, as in birds. It gives many small branches to the connecting membrane of the viscera, but the principal branches of each side form two intricate plexuses, which are in the place of the semilunar ganglia; the superior or smaller portion follows the branches of the cœliac artery to the stomach, the lower or larger, the branches of the mesenteric artery to the intestines. Other branches pass from the sympathetic to the kidney, and the spinal nerves keep sending filaments towards this part, which seems to be the situation of the prolongation, and it is continued down to the side of the rectum, communicating with all the spinal nerves until their extreme minuteness prevents their further continuation from being easily followed.

9. First cervical nerve. Some of the cervical nerves are seen passing to the muscles and skin of the neck; those of the axillary plexus to the muscles

and skin of the anterior extremity; those of the dorsal region principally to enter into the structure of the great shell; some of the lowest dorsal, the sacral, and caudal, are given to the muscles and skin of the posterior extremity, and the generative and contiguous parts.

10. Fifth cervical nerve. This, with the two next and the first dorsal, form the axillary plexus, from which many branches proceed to the large muscles of the shoulder and arm, and the skin; besides these there are three large nerves, somewhat resembling the median, the spiral, and the circumflex.

11. Median nerve: it descends and divides into large branches, which pass into the substance of the hand, and give branches to the tendinous and muscular parts, and send others towards the skin in the form of digital nerves.

12. Spiral nerve; it gives some muscular branches in its course, and passes round to the outer side of the arm-bone, and divides and sends a branch through the outer condyle to join another, which is the principal continuation of the nerve, to terminate on the skin at the outer margin and back of the hand.

13. Circumflex nerve; it passes upwards beneath that muscle resembling the broadest of the back, and gives a branch to the larger teres muscle, and is then directed downwards, to terminate on the skin at the back of the arm.

14. Ninth dorsal nerve; from this and the tenth, the nerves representing the anterior crural, obturator, and other nerves, usually proceeding from the lumbar, are given off; these are distributed on the muscles and skin connected with the superior part of the pelvis and thigh.

15. Sciatic nerve; it is principally formed by the eleventh dorsal and first sacral nerves; it however communicates with the tenth dorsal and second sacral; it divides into two principal parts, one of which gives branches to the muscles of the thigh, and is continued on the under surface of the foot, and terminates on the skin like digital nerves; the other, after giving off some muscular branches, passes to the skin, &c., at the upper surface of the foot.

PLATE XVII.

Fig. I.

THE BRAIN OF THE TURTLE.

(TESTUDO MYDAS.)

1. Striated body, and a lesser oblong eminence seen on opening the lateral ventricle; on the left side the choroid plexus is seen passing through an opening in the septum, to communicate with that of the right side; part of the striated body has been removed on the right side.
2. Thalamus of the optic nerve.
3. Optic lobe and ventricle continued forward under the thalami, and forming a resemblance of the third ventricle, and then backwards into the cerebellum, and to the calamus scriptorius.

Fig. II.

(THE SAME.)

1. Cut surface, from which the striated body has been removed; it is the crus of the brain, and is somewhat connected with the commissure of the optic nerves: the thalamus on this side has been cut off at its connection with the optic tract.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 9

Fig. 7.

Fig. 8.

Fig. 5.

Fig. 6.

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2. Optic lobe, from which more has been removed than in the preceding figure.
3. Cerebellum, from which more has been removed than in the preceding figure; two longitudinal bands are continued on from the base of the optic lobes, and terminate near the calamus scriptorius, by being implanted into the anterior portion of the oblong medulla; on each side of these, others less distinct may be observed.
4. Fourth nerve.

Fig. III.

(THE SAME.)

1. Optic tract, principally derived from the thalamus, but also communicating with the optic lobe.
2. Crus of the brain passing above the optic tract, but communicating somewhat with it and the part surrounding the infundibulum.

Fig. IV.

(THE SAME.)

A portion of the optic nerve has been removed; the crus of the brain is seen passing from the anterior lobe to the oblong medulla.

Fig. V.

THE FROG.

(RANA TEMPORARIA.)

This figure shows the nerves as they are distributed on the anterior or inferior part of the body.

1. A branch from the ganglion joining the par vagum ascending to communicate with a branch of the fifth, passing to the palate.
2. Trunk of the par vagum.
3. A nerve resembling the glosso-pharyngeal to the throat.
4. Hypo-glossal nerve given to the tongue.
5. A large nerve in the place of the axillary plexus.
6. Sympathetic nerve, formed from branches of the spinal nerves, which communicate with each other before they terminate on the viscera.
7. One of the pearly bags, or vesicles, connected with the nerves at their exit from the spinal canal.

Fig. VI.

(THE SAME.)

This figure shows the brain, and posterior or superior surface of the spinal cord. There are the same parts as in the snake.

1. Anterior lobes of the brain from which the olfactory nerves proceed.
2. Thalami of the optic nerves.
3. Optic lobes.
4. A narrow transverse band, which is the cerebellum, and behind this the ventricle at the calamus scriptorius.
5. A large nerve, instead of the axillary plexus: it is formed of an anterior and posterior bundle, the posterior having a ganglion attached to it. The canda equina is seen forming the nerves of the lower extremities.
6. Anterior crural nerve.
7. Sciatic nerve: some of the white vesicles are seen, which are supposed to contain cretaceous matter.

Fig. VII.

THE BRAIN OF THE SNAKE.

(BOA CONSTRICTOR.)

1. STRIATED body and oblong eminence near the middle line, seen as in the turtle, on opening the lateral ventricle.
2. Optic lobe opened.
3. Cerebellum extending over the ventricle at the calamus scriptorius: the sides of the ventricle have been rather too much separated.

Fig. VIII.

(THE SAME.)

In this figure are seen the commissures of the optic nerves, in which the tracts join; the nerves do not cross by one's being super-imposed.

1. The cut portion of the crus of the brain from which the striated body has been separated.

Fig. IX.

(THE SAME.)

The spinal cord is continued quite to the end of the tail, and has cineritious matter within it, similar to that in mammalia. It gives off anterior and posterior bundles of nerves; but their roots are very close to each other, and there is a ganglion attached to the posterior. At the anterior point, the anterior bundle becomes united with it: each anterior bundle is rather larger than the posterior.

Fig. 1.

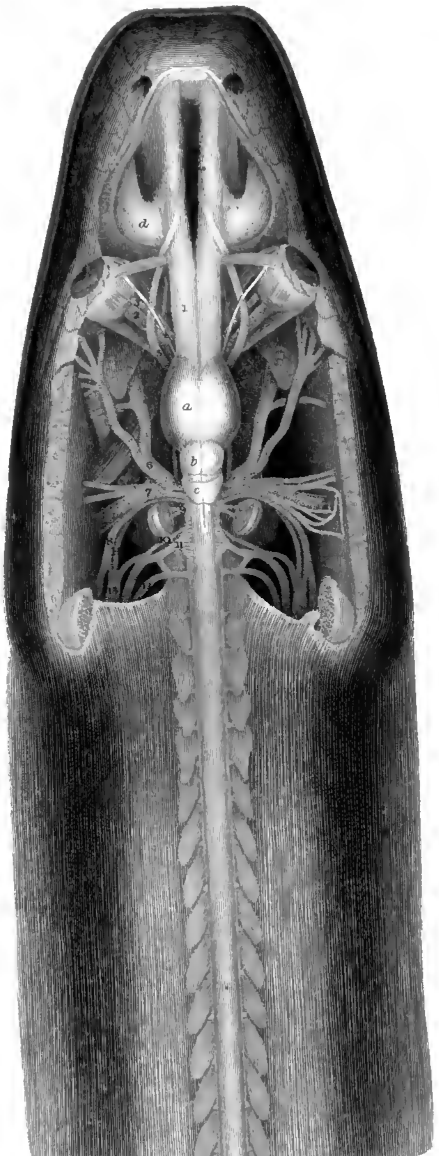

Fig. 2.

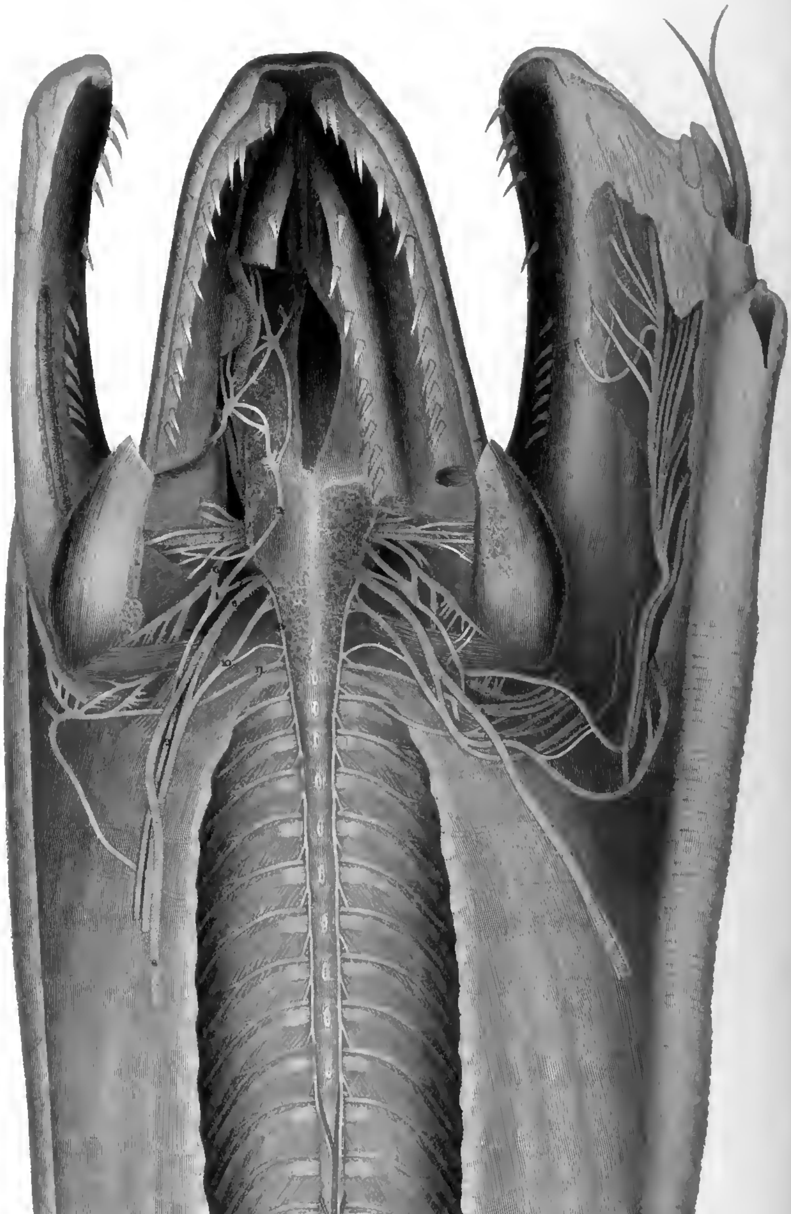

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PLATE XVIII.

Fig. I.

THE ORIGIN OF THE CEREBRAL NERVES OF THE SNAKE.

(BOA CONSTRICTOR.)

The figures of this and the following plate are the exact size of a snake nine feet long.

a. Anterior lobe of the brain; *b.* Optic lobe; *c.* Cerebellum; *d.* Schneiderian membrane of the nose.

1. Olfactory nerve; it is fibrous, and different from the soft texture of the brain; it is joined by the first trunk of the fifth near its entrance at the nose, and the branches proceeding from it are then distributed over the Schneiderian membrane.
2. Optic nerve.
3. Third or common oculo-muscular nerve cut short.
4. Fourth nerve given to the superior oblique muscle of the eye.
5. First trunk of the fifth; it passes forward first within the cranium, then into the orbit, and from this part to the Schneiderian membrane, on which it becomes connected with the olfactory nerve.
6. Second trunk of the fifth.

7. Third trunk of the fifth.
8. Hard portion of the seventh nerve.
9. Auditory nerve.
10. Glosso-pharyngeal nerve.
11. Trunk of the par vagum.
12. Ninth nerve.
13. Ganglion of the sympathetic nerve, as in 1, Fig. 2.
14. A branch of the sympathetic nerve passing to the palatine nerve, as in 2, Fig. 2.

Fig. II.

THE CONTINUATION OF THE CEREBRAL NERVES.

1. Ganglion of the sympathetic nerve, situated near to and connected with the trunk of the par vagum.
2. A branch of the sympathetic nerve passing some way in a canal at the base of the cranium, and forming a small ganglion with a branch of the second trunk of the fifth; it sends filaments to the membrane covering the posterior part of the mouth and palate, one of which communicates again with the second trunk of the fifth before its termination; the ganglion then sends another branch forward to form another ganglionic union with a branch of the second trunk of the fifth, and from this a branch is sent to the posterior part of the nose to ramify on the Schneiderian membrane; other branches are given to the membrane covering the mouth and palate, and one passes forward and communicates again with a branch of the second trunk of the fifth, and is distributed on the membrane covering the anterior part of the mouth and palate. It is worthy of remark, that the nerves distributed on the membrane of the mouth, palate, and nose, communicate so many times with branches of the second trunk of the fifth, and their connexion is so

much greater than in the turtle; but in this creature the palate is horny, and not so extensive in proportion to the size of the head.

3. Prolongation of the sympathetic connected with the trunk of the par vagum, but not directly with the ganglion of the sympathetic; it communicates with the ninth nerve, then passes down the spine, and communicates with the eleven superior spinal nerves; it emerges on each side at the place the superior branches of the vertebral artery enter to distribute branches in the intercostal spaces; it is continued downwards in a very fine plexiform prolongation with the vertebral artery, as far as the origin from the right aorta; it then branches to each side beneath the membrane connecting the viscera with the ribs and spine, and communicates with filaments of the par vagum; it is afterwards continued downwards, receiving a filament from each spinal nerve; in its course it is a very fine nerve, and has not any more ganglia than the first, and those communicating with the second trunk of the fifth, but, at different points from which the nerves pass to the viscera, there is an appearance of a delicate plexus: this plexiform structure varies in different parts, and becomes much greater about the beginning of the intestine, where it resembles that corresponding with the semilunar ganglion in the turtle; near the kidney it assumes the form of a nervous membrane or retina before it is distributed on the urinary and generative organs. Branches pass from the plexuses with the arteries to the different viscera.

4. Second trunk of the fifth; after communicating with the sympathetic, and giving filaments to the membrane of the mouth, palate, and nose, it passes out of its canal in the upper jaw, and terminates in branches on the upper lip.

5. Third trunk of the fifth; it gives branches to the muscles of the jaws, the greatest portion of it then passes within a canal in the lower jaw; it sends three branches through the opening at the inferior margin of this part, two of them to communicate with the branches of the par vagum and ninth distributed on the muscles and parts underneath the jaw; the other to give filaments to the membrane of the mouth as far as the sheath of the tongue; the trunk is continued onwards through the foramen near the chin to divide into branches and terminate on the lower lip.

6. Hard portion of the seventh; it communicates with the ganglion of the sympathetic, and then passes through the digastric muscle, to which it gives a branch; it communicates with the first spinal nerve, and terminates on the costa-maxillary muscle.

7. Glosso-pharyngeal nerve; it passes to the ganglion of the sympathetic.

8. Trunk of the par vagum; it communicates with the sympathetic, and then with a branch that appears to be the continuation of the glosso-pharyngeal from the ganglion of the sympathetic; it sends a branch to communicate with the ninth to pass to the muscles, &c., of the fauces; and is then continued downwards close to the trachea in company with each jugular vein; on the left side it also accompanies the carotid artery, and from this a small vessel also ascends with the right trunk; it sends filaments on the large vessels towards the heart, and others behind each aorta similar to the recurrent nerves, to be distributed on the trachea and œsophagus; each trunk, for a short space, accompanies its corresponding pulmonary artery: a little above the liver it passes in front of the superior part of the lungs, and proceeds a short distance, where it is joined by its fellow to form a single nerve; this is continued downwards under a thick membrane on the liver, and appears to give filaments to this viscus, the lungs, and œsophagus; about the termination of the liver it sends a large branch, which has communicated freely with branches of the sympathetic, to the left surface of the stomach, this gives filaments to the lowest part of the lungs, and terminates on the stomach. The right division, or the continuation of the nerve itself, having communicated several times with the left division and filaments from the plexus of the sympathetic, is continued a short way on the membrane connecting the viscera; it passes on the right surface of the stomach, distributing branches to this viscus, and terminates on the beginning of the intestine, reaching as far as the pancreas.

9. A nerve from the ganglion of the sympathetic; it appears to be the continuation of the glosso-pharyngeal after its junction with the ganglion; it communicates with the ninth after its connexion with a branch of the trunk of the par vagum, and terminates on the glottis and muscles attached to the anterior point of the jaw for drawing forward the trachea.

10. Ninth nerve; it receives a branch from the trunk of the par vagum, and from the hard portion of the seventh, after this has communicated with the first cervical nerve; it gives off several branches to the muscles of the tongue and throat, and one that reaches to the end of the tongue, and one to communicate with branches of the third trunk of the fifth, issuing out of the inferior part of the lower jaw. The glosso-pharyngeal, the trunk of the par vagum and the ninth, are so connected together that it is difficult to determine precisely to which nerve each branch belongs; they have been with great care apportioned to their respective nerves in this description; their final distribution will be seen in Plate XX.

11. First cervical nerve; it communicates with the hard portion of the seventh and the ninth, and then passes towards the angle of the jaw, distributing branches to the thin muscle, the costa-maxillary, and the continuation of this over the throat, which resembles the constrictor muscle in the turtle and the cutaneous in man.

PLATE XIX.

THE SYMPATHETIC NERVE OF THE SNAKE.

(BOA CONSTRICTOR.)

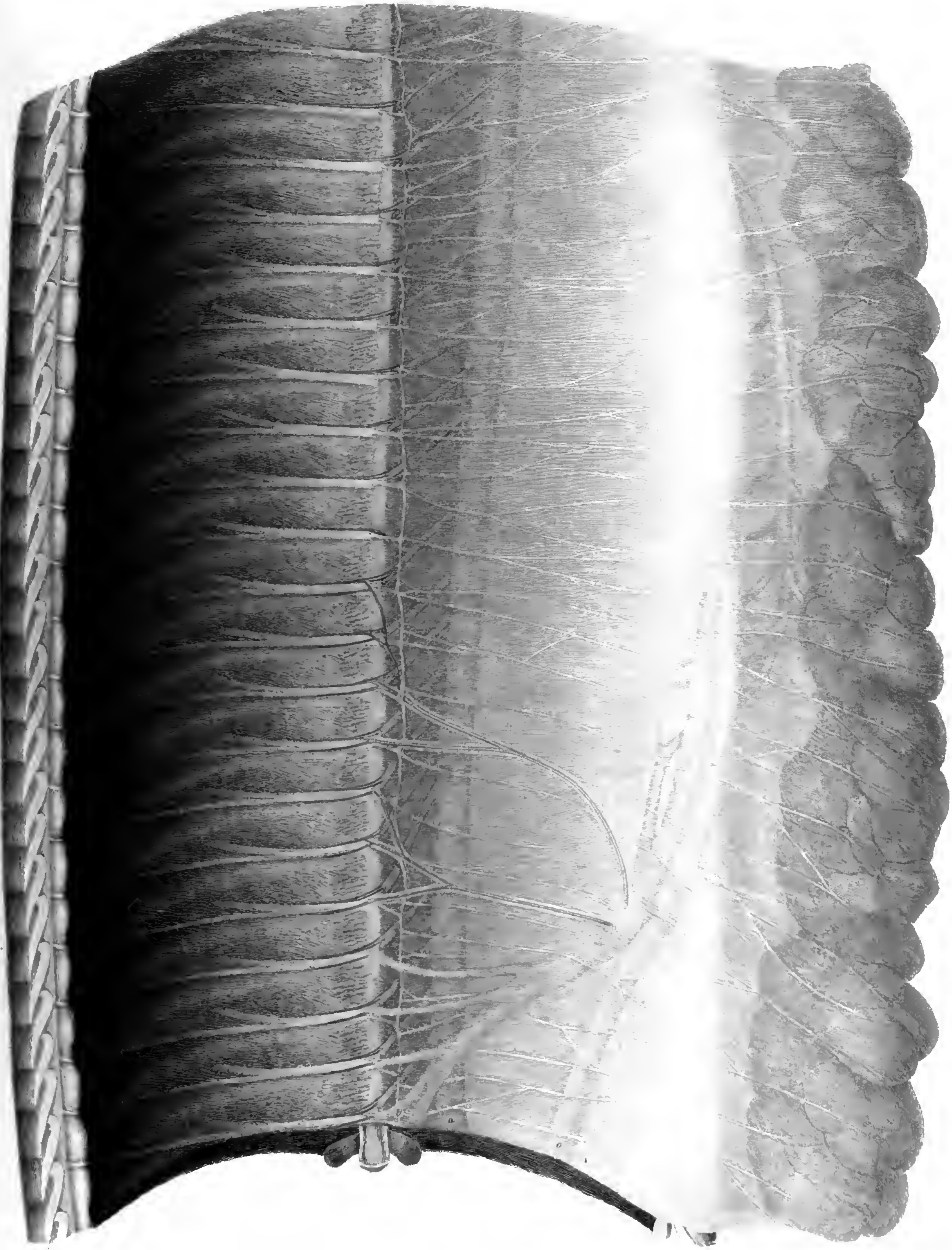
This view is taken from about the middle of the body of the same snake as in the preceding plate. The sympathetic is seen communicating with each spinal nerve, and then sending filaments on the membrane connecting the viscera with the spine and ribs, some of which are distributed on it, and continued as far as the fat contained in its anterior folds, whilst others pass to the viscera, bloodvessels, &c.

a. Aorta; *b.* Vein receiving blood from the intercostal spaces; *c.* Gall duct.

1. Right division of the par vagum a little before its termination on the stomach.

2. Sympathetic nerve.

Without previous preparation, it is impossible to observe the extreme complexity, delicacy, and extent of the branches of the sympathetic in the snake. They present one of the most wonderful displays of minute structure that can be observed. In the recent state of the animal, the nerves from just below the head are so transparent, as to be with great difficulty distinguished from the surrounding parts; but after the animal has been opened through its whole length, and the connecting membrane of the viscera separated to a little distance from the margin of the ribs; after it has been immersed in water for a few hours, and then in spirits, or a solution of oxymuriate of



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mercury for a few days, and has had the membrane carefully detached nearly as far as the spine, the fine branches proceeding from the spinal nerves may be seen passing upon this membrane to a cord in some parts, and in others to a complicated plexus, varying in different parts according to a prescribed law, but observing a similar disposition to corresponding but varied distributions in other orders. So long, however, as it preserves the form of a cord, although it has communicated with a great number of spinal nerves, and does not acquire an increased size, it is sufficient for the consent of all the parts supplied, but not for imparting to them the required nervous influence for the performance of their functions. It therefore shows that it exists for producing a sufficient sympathy between all the cerebral and spinal nerves communicating with it, as well as between all the viscera; but that the nervous power each part requires rather depends on the local connections through it with the spinal cord and nerves, than on any power that can be conveyed from the distant cerebral nerves through such an extended prolongation without a more material increase of size than is apparent.

PLATE XX.

THE SNAKE.

(BOA CONSTRICTOR.)

FIG. I.

THE parts on the right side have been drawn outwards, to allow room for showing the nerves.

1. Three branches of the third trunk of the fifth issuing from the lower jaw; two of them communicate with the ninth, as in 5; the other gives branches to the membrane of the mouth as far as the sheath of the tongue.
2. Hard portion of the seventh.
3. Trunk of the par vagum.
4. A nerve corresponding with that in 9, Fig. 2, Plate XVIII., derived from the ganglion of the sympathetic, and appearing to be the continuation of the glosso-pharyngeal nerve: it terminates on the glottis and the muscles attached to the anterior part of the jaw for drawing forward the trachea.
5. Ninth nerve, joined by a branch from the trunk of the par vagum; it gives branches to the muscles of the tongue and fauces, one of which becomes imbedded in the hyo-glossal muscle, and receives communicating branches from the same nerve in its course to the tip of the tongue; it communicates

Fig. 1.

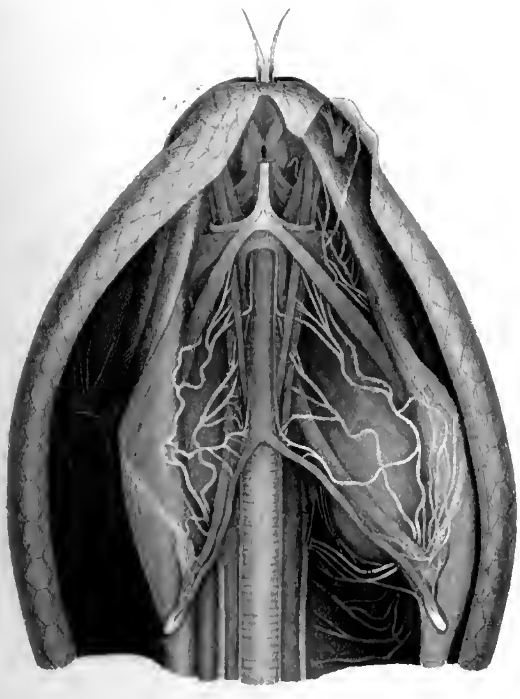


Fig. 3.

Fig. 4.

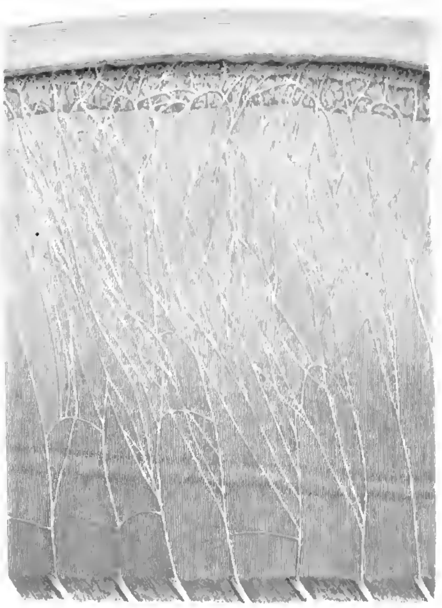
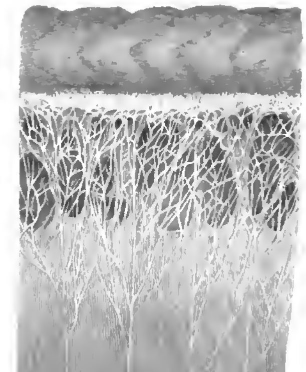


Fig. 2.

Fig. 5.



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2. Second trunk of the fifth, terminating on the upper lip.
3. A branch from the palatine ganglion, described in 2, Fig. 2, Plate XVIII., from a union of a branch of the sympathetic with one from the second trunk of the fifth, passing to the membrane covering the septum of the nose.
4. Olfactory nerve.

Fig. IV.

(THE SAME.)

The sympathetic nerve near the beginning of the intestine is shown, taking a different disposition from that in the part higher up, which has been exhibited in Plate XIX.; it accords in a considerable degree with the plexus of the turtle, which is in the place of the semilunar ganglion, and gives off numerous nerves to the intestines.

Fig. V.

(THE SAME.)

This shows the sympathetic lower down than the preceding figure; it forms a plexus resembling a retina, from which branches are sent to the ovary, the oviducts, and kidney. The distribution is the same in the male, except that the branches terminate on the testis and vas deferens, instead of the ovary and its duct.

with two of the branches of the third trunk of the fifth issuing from the inferior part of the lower jaw, to be distributed a little more forward on the membrane and skin covering this part.

6. First cervical nerve.
7. Branches of cervical nerves given to the integuments.

Fig. II.

(THE SAME.)

1. Trunk of the par vagum.
2. Recurrent nerves, which are very small; a great portion of the trachea receiving filaments from the trunk of the par vagum.
3. Trunk of the par vagum passing downwards to be united with its fellow; but the union takes place lower than is here represented.
4. Continuation of the sympathetic in the form of a plexus near the vertebral artery; in the neck, for some distance, it appears to join branches of the spinal nerves issuing from between the attachments of the muscles on the anterior part of the spine, near to the extremities of the ribs, to be distributed on the œsophagus.

Fig. III.

(THE SAME.)

1. Continuation of the first trunk of the fifth, as in 5, Fig. 1, Plate XVIII., to terminate on the skin at the end of the nose; before leaving the orbit, it also gives off a ciliary branch, and one to the skin above the upper eyelid.

AVES.

BRAIN.—In birds the hemispheres of the brain assume a larger size in proportion to the body than in the preceding classes. The surface of the brain is smooth and without convolutions; it contains two lateral ventricles, having very thin posterior parietes, and separated from each other by the radiated septum; each contains a very large striated body which projects into it and occupies the greater proportion of its space. Underneath the floor of the ventricles are the thalami, and between these the third ventricle, which extends posteriorly into the optic lobes and into and underneath the cerebellum to the calamus scriptorius. Two cords, the crura of the brain, proceed from the hemispheres anteriorly, and pass just above the optic tracts to the oblong medulla. There is an anterior, posterior, and soft commissure. Behind the thalami are situated two rounded and rather flattened bodies, the optic lobes, which contain ventricles; behind these the cerebellum is situated, it is formed of a large convoluted middle lobe with a lobule extending from each side, it is connected with a pedicle on each side to the oblong medulla, it contains at its inferior part a ventricle, which communicates with that leading from the third and optic lobes to the calamus scriptorius. At the base of the brain the prominence is seen in the situation of the mammillary eminences, and behind these the oblong medulla much larger than the spinal cord.

CEREBRAL NERVES.—The olfactory nerve proceeds from the anterior lobe of the brain, it spreads round the superior part of the Schneiderian membrane, and thus forms an appearance of a hollow ganglion before its termination. The optic nerve

proceeds from the optic tract, which is connected with the thalamus, the pedicle of the striated septum, and the optic lobe; it is connected with its fellow in a commissure, and from this the nerve proceeds to the eye to terminate in the retina. The third nerve arises from the oblong medulla, it gives a branch to join a filament from the first trunk of the fifth to form ciliary nerves, and then supplies the inferior oblique muscle, the adductor, levator, and depressor. One half of the larger portion of the fifth arises from the sensitive tract and the other half from the involuntary and forms a ganglion, the smaller portion arises from the motive tract, superficially it is not very distinct from the larger. The first trunk passes through the orbit and enters the nose close to the olfactory nerve and appears connected with this, and gives filaments to the Schneiderian membrane; it meets its fellow on the floor of the nose, and then gives off a large branch to the exterior of the upper jaw near the beak, and another to divide on the palate and send branches through perforations in the bone to the membrane covering the beak. The second trunk passes beneath the orbit to the posterior part of the beak and palate, and divides into branches which supply the covering of those parts. A part of the third trunk has a separate origin from that proceeding from the ganglion; it gives branches to the muscles of the jaws connected with the omoid and square bones, and then enters a canal in the lower jaw, and sends filaments through perforations to the masseter and other muscles, and to the teeth and membranous covering of the lower jaw, and particularly the beak; a branch is given to the mylo-hyoideal muscle, and one analogous to the maxillary portion of the digastric: in the goose it is small, it is larger in the crane, and of great size in the pelican, for supplying the extensive bag of the fauces. The sixth nerve arises from the oblong medulla in the track of the pyramidal body, and is given to the abductor muscle of the eye and the muscles of the nictitating membrane. The hard portion arises from the oblong medulla in the track of the restiform body, it enters a foramen anteriorly to the auditory nerve, it passes downwards and backwards on the outer side of the vestibule, and escapes at a foramen in the posterior part of the external auditory meatus, after it has communicated with the sympathetic nerve; it then sends branches to muscles analogous to the superior belly of the digastric and stylo-hyoideal, and communicates

with a branch of the second cervical nerve, to terminate on a cutaneous muscle connected with the external auditory meatus and the posterior part of the face and the upper part of the neck. After it has communicated with the second cervical nerve it passes down and appears to communicate with the third and then with the fourth; and although the fourth communicates with the fifth, and this with the next, and so on, it cannot be determined that it is through the continuation of the hard portion; in the pelican it becomes connected with several cervical nerves in the manner already described, the branches of which terminate on the skin and cutaneous muscle, and communicate with branches of the conjoined glosso-pharyngeal, par vagum, and ninth. In the crane, after giving a branch to the digastric muscle, and communicating with the second cervical nerve, the par vagum, and glosso-pharyngeal, near the junction of this with the ninth, it sends a branch to terminate on a thin slip of muscle analogous to the stylo-hyoideal in the goose, and then becomes connected with other cervical nerves in passing down the neck. The auditory nerve arises behind the hard portion in the track of the restiform body, it enters its foramen posteriorly to that of the hard portion to pass to its distribution in the labyrinth of the ear. The glosso-pharyngeal arises with the par vagum from the oblong medulla in the track of the restiform body, it passes out in an osseous canal; it communicates with the superior cervical ganglion of the sympathetic. In the goose it gives a branch to the pharynx and œsophagus, and the muscles connected with the glottis, and then passes near the lower jaw to the hyoid bone, gives a branch to the cerato-maxillary muscle, and reaches towards the surface of the tongue, distributing filaments as far as the tip, and communicating with branches of the opposite side. In the crane it becomes united with the ninth, branches are then given off as they are from the separate nerves in the goose: in the pelican it becomes united with the trunk of the par vagum, and then divides into numerous branches for the muscles of the fauces, the pharynx, and trachea; a larger one accompanying the long muscle, resembling the genio-hyoideal, or hyo-glossal, as far as the beak. The par vagum arises with the glosso-pharyngeal from the oblong medulla in the track of the restiform body, and after having communicated with the sympathetic, the glosso-pharyngeal, and ninth, passes down the neck accompanied by the internal jugular vein;

on the right side it extends over the arch of the aorta, and sends the slender recurrent nerve round this vessel to the œsophagus; it then gives branches to the lungs and passes over the right branch of the pulmonary vein to the left side, to join the left trunk, after it has given filaments to the pulmonary artery and vein. The left trunk near the bifurcation of the trachea sends up its slender recurrent nerve, which gives filaments to the trachea, but its principal part terminates on the œsophagus; the par vagum gives filaments to the lungs, and sends a large branch down on the œsophagus to terminate on the enlarged part of this canal near the gizzard; it then passes over the pulmonary vein after it has given filaments to this and the pulmonary artery, it is afterwards joined by the right trunk, so as to form one cord, which passes down on the front of the œsophagus to terminate on the gizzard, after it has communicated with filaments from the splanchnic nerves accompanying the cœliac artery. The lengthened origin of the par vagum may resemble part of that usually belonging to the accessory in mammalia. In the crane it descends, adhering to the spinal nerves; it gives branches to the trachea and lungs and the large vessels of the heart; it sends off the recurrent on each side, to give branches to the œsophagus, the lower larynx, and its muscles; it then sends a branch downwards on each side of the stomach; the rest of each trunk becomes joined in front of the œsophagus, passes on the stomach as far as the cardiac extremity, and sends filaments to communicate with branches of the splanchnic nerve, as well as the one passing on the cœliac artery. In the pelican, after emerging from the cranium the par vagum becomes united with the glosso-pharyngeal and ninth, and sends off a large branch to join the one proceeding from its previous union with the glosso-pharyngeal; it sends off another larger branch to join this union; it then receives a branch of the second cervical nerve, and passes to its termination nearly, as in the crane. The ninth arises from the oblong medulla; after it has passed through its foramen it communicates with the sympathetic. In the goose it gives a branch to the hyo-laryngeal muscle placed at the side of the trachea, and sends a large branch forwards to give a branch to the hyo-glossal and lingual muscles. In the crane and pelican it becomes connected with the glosso-pharyngeal.

SPINAL CORD.—The spinal cord in the swan is continued from the oblong medulla; it passes down of nearly the same size; about the middle of the neck it is rather smaller, and at the lower part begins to increase, and becomes still larger about the middle of the portion, giving off the nerves to the axillary plexus; it then gradually diminishes, and a great part of the thoracic portion continues of nearly the same size as the upper part of the cervical; towards the loins it increases again, and becomes most enlarged about the middle of the portion, giving off the nerves to the lower extremities. A little above and below this part, there is a separation of the two posterior halves of the cord at the ventricle, which is covered only by membrane; the spinal cord begins to diminish again, and becomes gradually less as it approaches the extremity of the tail. In the dorsal and lumbar portions, where no motion is allowed, the cord fills the spinal canal, and in many parts is covered closely by a thin plate of vitreous bone. The anterior and posterior bundles of each nerve are of nearly the same size; and in one of the largest nerves, the anterior bundle could not be so clearly separated from the ganglion as in man, neither in the turtle.

SPINAL NERVES.—The number of the cervical nerves is various in different species, each of them is divided into an anterior and posterior trunk; the anterior is given to the muscles and skin, and the posterior principally to the muscles; but generally the three inferior and first dorsal form the axillary plexus. In the swan the two preceding cervical nerves communicate together, and then with the first entering the plexus, and are distributed on the muscles at the posterior part of the scapula, corresponding with the trapezius, the levator of the scapula, and rhomboid, and on the skin. Several branches from the plexus are given to the pectoral muscles, and that resembling the great serrated. The circumflex nerve passes from the spiral; it gives a branch to a muscle analogous to the broadest muscle of the back, and is then distributed on the deltoid. The internal cutaneous passes from the trunk, giving off the median and ulnar, and descends at the inner side of the humerus to the skin. The spiral nerve gives branches to the teres and scapular muscles; it sends branches to the internal brachial muscle, and the extensor corresponding with the triceps: in passing behind the fore-arm it gives a branch to supply the skin; at the back of the ulnar it

gives a branch to the radial muscle, and a muscle corresponding with the short supinator, to the external ulnar, and the other muscles analogous to the extensors of the wrist and fingers, and then passes close to the interosseous ligament to the skin and other parts of the back of the pinion. In the pelican a similar branch is traced to the back of the pinion; it there divides into two branches, one to be distributed on the skin at the edge of the thumb, the other to the muscles and skin at the middle part, as far as the extremity of the finger. In the swan the external cutaneous nerve arises from the median, and descends to supply the skin on the outer side of the fore-arm. The ulnar is a branch from the median; it passes over the inner condyle of the humerus, and gives filaments to the skin of this part, and to the internal ulnar muscle; it sends a branch down the fore-arm on the outer side of this muscle to the skin on the outer edge of the pinion; another branch passes underneath, and then at the inner side of the internal ulnar muscle to terminate on the palmar face of the pinion. In the pelican a branch corresponding with the last is conveyed underneath, and adhering to the tendon of a similar muscle, to supply the muscles and skin of the palmar face of the pinion, and communicate there with a branch of the median. In the swan the median sends a branch under the head of one of the pronators of the radius, and gives filaments to this muscle, and the other pronator of the radius, and passes down to the skin as far as the pinion; another branch passes behind these muscles, and reaches the ulnar side of the inner pronator of the radius, and passes down the fore-arm to the pinion, and divides into two branches to be distributed on the thumb and fore-finger. In the pelican this branch is divided in the same manner, one supplying the muscles of the thumb and skin; the other, after communicating with the ulnar, is extended along the fore-finger to the skin. In the pinion of the swan, very distinct little muscles are observed for giving motion to the quills, and thus form a variety of the cutaneous muscle. The dorsal nerves, after giving filaments to the intercostal muscles and the rudiment of the diaphragm, pass to the skin of the side. In the pelican several of the intercostal nerves, after they have passed from between the ribs, are formed into a plexus near the wing, before their final distribution on the skin. The lumbar and some of the sacral form the nerves of the lower extremity, and the rest to the

termination of the spinal cord are given to the muscles and skin of the cloaca and tail. In the swan the anterior crural nerve is formed by the first, second, and third lumbar nerves, and is accompanied by a small artery; it is given to the muscles which are in the place of the gluteal, the tensor of the fascia of the thigh, the straight muscle, the external and internal vast, and the crural, and sends off a slender branch, the saphenus, to be joined by another from the obturator to pass down on the inner side of the leg. The obturator nerve arises from the second and third lumbar nerves, and after giving off the branch to join the saphenus, terminates on the obturator and pectineal muscles. The sciatic nerve arises from six nerves below the third lumbar, and is accompanied by the femoral artery into the thigh; after giving branches to the adductor and the flexors at the back of the thigh, which are in the place of the biceps, the semimembranous, and semitendinous, it passes down and divides into the posterior tibial and peroneal nerves. The posterior tibial divides into two portions; one gives branches to several muscles corresponding with the inner part of the gastrocnemius, the posterior tibial, and the flexors of the toes, and sends one down to the skin at the inner side of the leg; the other portion is given to the heads of the muscles forming the outer part of the gastrocnemius. The peroneal sends a branch down the leg behind the tendons towards the outer malleolus, and from thence to be distributed on the sole of the foot: the course of this corresponds with that of the posterior tibial in mammalia. The peroneal passes to the outer side of the leg, and gives branches to the muscles corresponding with the peroneal, the anterior tibial, and the extensor of the toes; it gives off the anterior tibial, which passes between the peroneal muscle and the extensor of the toes, and under the annular ligament, and gives a branch to the inner side of the first or inner toe, and another to divide for the outer side of the first toe, and the inner side of the second. The continuation of the peroneal becomes superficial about the lower part of the leg, and passes over the annular ligament at the ancle, and then between the tendons of the second and third toes, and divides for the outer side of the second and the inner side of the third; another slender branch passes from between the muscles on the outer side of the leg, and is distributed on the skin about the outer ancle.

SYMPATHETIC NERVE.—The superior cervical ganglion of the sympathetic nerve, in the swan, lies between and is connected with the trunk of the par vagum and the glosso-pharyngeal at their exit from their osseous canals, and is partly placed upon the latter nerve; in the pelican it is situated on the glosso-pharyngeal; in the swan it sends off a superior branch, which passes with a large artery to the orbit, and communicates with the second and third trunks of the fifth, and with the hard portion of the seventh; the superior branch also sends a branch beneath the slender bone of the tympanum to join the inferior branch close to the glosso-pharyngeal nerve. The inferior branch passes with the internal carotid artery; it begins by a branch passing upwards from the glosso-pharyngeal nerve; it receives a branch from the superior branch passing beneath the slender bone of the tympanum, and is continued onwards and receives a branch from the hard portion of the seventh; it then divides into two branches, one passes into the orbit to Harder's gland, and communicates with the first trunk of the fifth; it sends another to the posterior part of the palate and nose, which in the goose communicates with the second trunk of the fifth. In the swan the superior cervical ganglion sends a branch down the neck with the carotid artery; this in the pelican at the bifurcation of the carotid joins that of the other side; it gives filaments to branches of the artery, and to communicate with the prolongation of the sympathetic, accompanying the vertebral artery; at the bottom of the neck it dips down between the anterior cervical muscles, and divides into two branches to join the last cervical ganglion but one on each side. In the swan the superior cervical ganglion then sends off the prolongation to accompany the vertebral artery; this communicates with the ninth, and then with the anterior trunk of each spinal nerve; at the bottom of the neck it emerges from the vertebral canal and is continued through the thorax, and near its entrance into this begins to form a double communication with the spinal nerves, one branch passing over, the other underneath, the head of each rib. The ganglia are connected with the ganglia of the six dorsal nerves after the first, but the rest, the cervical and the lumbar, are connected with the cervical and lumbar nerves, and not with the ganglia. On separating the anterior and posterior bundles of one of the largest spinal nerves, the sympathetic appears to communicate quite as

much with one as the other. Branches from the first thoracic ganglion communicate with the pulmonary branches of the par vagum, and accompany the large blood-vessels to the heart. The first large splanchnic nerve proceeds from the thoracic portion, and after communicating with that of the right side on the cœliac artery, the branches proceed from the union along the branches of this artery to the liver, the upper portion of the small intestines and the gizzard, and on this organ communications take place with branches of the par vagum. The second large splanchnic nerve is formed by branches from the prolongation, and several thoracic ganglia; it corresponds more particularly with the splanchnic nerve of mammalia; it passes to the renal capsule, with which it becomes intimately united, and then distributes its branches to the small intestines and the ovaries or testes. After the second large splanchnic nerve has been given off, the sympathetic passes downwards and communicates with the spinal nerves; it sends some branches upwards to communicate with others from the splanchnic nerves, and give branches to the kidney, and several to the mesocolon, many of which advance forward, and form an arch near to that of the mesocolic artery, which at the superior part communicates with the splanchnic nerve, and gives branches to the intestines, and others to the delicate peritoneum. The sympathetic then communicates freely with the anterior trunks of most of the spinal nerves within the pelvis; those below the nerves given to the inferior extremity form several large nerves, which pass downwards to the muscles and other parts connected with the cloaca and skin. The preceding description will apply generally to this class, if an allowance be made for a difference in the number of the vertebræ and the size of the parts to be supplied with nerves.

The brain of birds differs from that of many of the amphibia in the form, and comparatively large size of the hemispheres. In the greater dimensions of the anterior lobes, in proportion to the olfactory nerves; in the very thin parietes of the posterior part of the lateral ventricles; in the shape and magnitude of the striated bodies; in the larger size, and different situation, of the optic thalami; in the flattened summit, but greater circumference of the optic lobes, and in the shape of the cavity, which corresponds with their external form. In the external shape and appearance

of the cerebellum; in its having convolutions; in the thickness of the parietes of its small cavity, which communicates with the other ventricles. In the absence of longitudinal eminences extending towards the calamus scriptorius, and forming the ventricular cord; in the greater thickness of the oblong medulla. It agrees in the presence of the anterior, posterior, and soft commissures; in crura extending to the oblong medulla, and in the similar arrangement and origin of the nerves.

It differs from that of many of the mammalia in the want of convolutions and the corpus callosum, or great commissure. In the great thinness of the posterior parietes of the lateral ventricles; in the radiated form of the septum, and the different construction of the floor of this cavity; in its being continuous with the sides of the ventricles, and not separate like the fornix. In the hollow optic lobes instead of the quadrigeminal bodies. It agrees in having small lateral lobes, similar to the lobules attached to the sides of the cerebellum in the monkey and some other animals, and also in their being placed in a hollow, partly surrounded by a semi-circular canal, which in man, and some animals, is occupied by part of the petrous portion of bone. It differs in the continuation of the third ventricle into the cerebellum as well as into the calamus scriptorius; in the want of the annular tubercle, although there is a considerable enlargement of the oblong medulla at this part.

The spinal cord in the neck is frequently thin and narrow for allowing extensive motion, but is thicker and broader at the parts from which the larger nerves arise; it is more prominent on each side at the origin of every nerve, and thus slightly resembles the unequal cord of some invertebrate animals; but it is in shape only, and not from the presence of ganglia. It is continued to the tail. It has a distinct ventricle at the loins, which is shut only by membrane; it is closely surrounded by a thin plate of bone at the immoveable vertebræ of the back; at the same parts each anterior and posterior bundle of nerves is similarly incased. The width of the canal of the moveable vertebræ shows that the space exists entirely for the free accommodation of the cord in flexion.

In the nerves there is very little difference from those of several of the amphibia. The olfactory is not so coarse; the glosso-pharyngeal is rather larger in proportion to

the par vagum, but several of the nerves vary in different classes, and correspond more or less in particular kinds of each; in the goose some nerves continue more separate in their course, and supply distinct muscles, similar to those in the turtle; and in the pelican and crane are more connected, and furnished to muscles which are very much interwoven with each other.

The nerves differ from those in mammalia in the clearer connection of part of the optic nerve with the optic lobe. In the different distribution of the branches of the fifth on a greater proportion of hard parts, or the thin or membranous coverings of these, instead of thick fleshy ones, and in the less defined smaller portion. In the varying size of the different trunks, according to the parts furnished by them, but particularly in the branch of the third given to the mylo-hyoideal muscle and the skin and membrane of the fauces, it being very large in the pelican, smaller in the crane, and much less in the goose. It differs in the absence of the branch of the third trunk forming the gustatory nerve. In the less extensive distribution of the hard portion of the seventh, and its connection with cervical nerves, and not with branches of the fifth in the face and throat and neck; its supplying however cutaneous muscles in these parts, as well as the digastric and one arising from the lower jaw, which is inserted into the hyoid bone and may be compared with the stylo-hyoideal. In the larger proportionate size of the glosso-pharyngeal nerve to the par vagum in some instances, its supplying the superior glottis in the same manner as the superior laryngeal in mammalia; it sends off a branch to furnish the cerato-maxillary muscle, which then rejoins the nerve, and passing forwards, gives branches all along the surface of the tongue, communicating towards the anterior part freely with branches of the opposite nerve. In the upper larynx and trachea, not being supplied by the par vagum, and a greater proportion of the recurrent terminating on the œsophagus and crop; in the conjunction of almost the whole of each trunk into one cord below the lungs, nearly like that in the snake; and its termination either on a gizzard or fleshy stomach. The ninth varies according to the difference of the parts it usually furnishes in mammalia; in the goose it supplies the long muscle on the side of the trachea, the hyo-laryngeal, the trachea, the hyo-glossal, and lingual. It may be a

question whether an accessory nerve really exists; if it does, its origin and connection with the par vagum are so close as not to allow of a separation. Many of the cerebral, as well as spinal nerves, pass through osseous canals.

The par vagum, the glosso-pharyngeal, and ninth, continue more separate from each other after their exit from the cranium in the birds, having the most perfect muscles attached to the hyoid bone, the tongue, and lower jaw; and more conjoined as these parts become less distinct, as in the crane, and particularly in the pelican; and in the last the nerves and muscles are more confounded than in the snake. Notwithstanding these muscles are so slender and confused, different nerves more or less conjoined supply them; it may therefore be concluded, that each portion performs a specific function, although the action of the whole is more combined and uniform than in the goose, in which the muscles are so distinct and powerful. It is very probable that the long muscle, which may be compared with either the genio-hyoideal, or the hyo-glossal in the pelican, which is supplied from the conjunction of these nerves, can draw the part of the great pouch occupying the median line into a ridge, and perform functions similar to but less perfect than those of the tongue, independently of any influence it exerts over the hyoid bone and upper larynx. In the pelican, the greatest part of the nerves supplying the upper and lower jaw, and the pharynx, or great bag, are covered with a black membrane.

There is very little difference between the spinal nerves of birds and those of amphibia or even of mammalia, except in the number in each region and the origin of the caudal lower down from the more extended spinal cord in the two inferior classes than in mammalia. The number of cervical nerves is very various, but the three inferior and the first dorsal generally form the axillary plexus, the branches proceeding from which observe a considerable similarity to those of mammalia. The number of dorsal nerves is generally fewer, and that of the lumbar, and sacral, and caudal varies, the dorsal nerves pass between the ribs nearly as in mammalia, supply the intercostal muscles and then terminate on the skin; in the pelican several of these were formed into a plexus near the wing before their final distribution on the skin, most probably for combining in action particular feathers.

Nerves are furnished from the lumbar and sacral for the lower extremities, and numerous small caudal nerves for the parts about the cloaca and tail. In the crane and pelican, branches of the cervical nerves are observed to communicate with those of the pharynx and the descending branch of the hard portion. In passing down the neck in the crane, the par vagum adheres to the cervical nerves by very fine filaments, but in the pelican, although there is a similar approximation, communicating filaments could not be recognized; it is most probable, therefore, that in the crane they may be mere expansions of neurilema.

The sympathetic nerve has many remarkable points of difference: the superior cervical ganglion is not so distinct in the swan and goose as in the pelican, but in the pelican it is more impacted in the glosso-pharyngeal nerve; the disposition of its branches is however similar. It sends off a superior branch to communicate with the hard portion of the seventh, and with the second trunk of the fifth close to the connection of this with the third trunk, and to give filaments to the lachrymal glands. The inferior branch passes with the internal carotid artery, and in the swan communicates again with the hard portion, sends a branch into the orbit to supply Harder's gland and join the first trunk of the fifth, and sends another branch forward to communicate with the second trunk of the fifth, and accompany the arteries of the palate and nose; in the pelican, the inferior branch does not appear to communicate with the hard portion, but to join the branch of the third nerve given to the inferior oblique muscle of the eye, and then supply Harder's gland and become connected with the first trunk of the fifth, and furnish a branch to the palate. The cervical portion of the sympathetic may be compared with that of the snake in its not having a cord or prolongation accompanying the trunk of the par vagum, it, however, corresponds in some measure also with that of the turtle, for in the swan a branch is continued down the neck with each carotid artery, and in its course communicates several times with its fellow. In the pelican the carotid artery is a single trunk dividing into two at the upper part of the neck, a branch passes from the superior cervical ganglion with each of these, and becomes united into one near their bifurcation; it gives off branches for the supply of the carotid artery, and to communicate

with the prolongation accompanying the vertebral, at the bottom of the neck it dips down in the median line between the anterior cervical muscles and divides into two branches, each joining the last cervical ganglion but one of the sympathetic. After it has communicated with several of the cerebral nerves, it is continued down the spine in a canal with the vertebral artery, resembling the prolongation in the imperfect canal in the snake, and the cord sent from the first thoracic ganglion and placed at the side of the neck in the turtle, and that accompanying the vertebral artery in mammalia. It adheres to the anterior trunk of each cervical nerve through a ganglion, and thus forms a peculiar mode of communication. Having reached the thorax, its ganglia are connected with those of the dorsal nerves, thus resembling, in a considerable degree, the same in the turtle; in the swan and pelican a large nerve may be seen on each side proceeding from the first thoracic ganglion to communicate with the pulmonary branches of the par vagum accompanying the large bloodvessels to the heart; the prolongation in the thorax is generally double, and becomes united at each ganglion, and gives off an upper splanchnic nerve, and an inferior one as in the turtle, which does not as in this animal form plexuses, or ganglia bearing any proportion to the size of those in mammalia; the upper splanchnic nerve accompanies the cœliac artery to the gizzard and liver, and to communicate with branches of the par vagum, and the inferior one is intimately combined with the renal capsule, and this in a remarkable manner with the ovary; it may therefore be a question whether the renal capsules are in any way concerned in reproduction; branches are given off which follow the ramifications of the mesenteric artery to the intestines; the prolongation in passing down the spine sends branches on the meso-colon to communicate with those of the inferior mesenteric plexus; also branches to the kidney, and others to communicate with the long branches of the spinal nerves destined for the cloaca and adjoining parts, and thus form a plexus corresponding in some degree with that in mammalia produced by the junction of the hypogastric plexus with branches of two or three of the sacral nerves.

The accompanying arteries of the thoracic portion of the sympathetic are two-fold like the double prolongation, one being derived from the aorta in the same manner as

the usual intercostal artery in mammalia and passing before the head of the rib, the other being continued down from the vertebral behind the same process, and both becoming joined into one to form the intercostal artery.

In birds there are the same leading parts as in mammalia, as the voluntary motive, the involuntary, the true visual and sensitive centres and tracts. The voluntary motive centres are contained in the exterior region of the brain, and the tracts pass as the crus of the brain underneath the optic tract, from the motive centres to the anterior portion of the oblong medulla. The oblong medulla is large, as in mammalia, and a considerable portion of it consists of the involuntary centre. The involuntary centre has its appropriate convolution, which is placed a little posterior to that of the true visual tract, and occupies the same place in the oblong medulla as in mammalia; it becomes intimately united with the optic tract. The true visual tract occupies the same place as in mammalia, but is situated nearer to the margin of the anterior lobe and more horizontally; its tract is inserted into the optic tract near the optic commissure. Each sensitive centre occupies the posterior surface of the oblong medulla, and the floor of the fourth ventricle forming the ventricular cords; it extends upwards, and communicates with the optic lobe, the thalamus, and the parietes of the lateral ventricle.

The optic tract begins from the surface of the thalamus; it receives a large addition from the optic lobe; it is broad and short; the pedicle of the striated septum joins the optic commissure in the same manner as part of the anterior crus of the fornix in mammalia. The true visual tract terminates in the optic tract; the involuntary centre also becomes connected with it; at the base, in some instances, it receives an addition from a geniculate body; it meets the opposite optic tract in the optic commissure, becomes connected with the eminence surrounding the infundibulum, and then terminates in the perfect optic nerve.

The striated septum answers in many respects to the character of the fornix. From its conjunction with the convolutions, and from having in its composition so much grey matter, it has higher functions than the fornix as a consensual agent between the several senses. The fornix, however, contains masses of grey matter in

the ox and sheep. The striated septum, from its structure, has some commissural peculiarities in consonance with a differently-formed brain, but may only combine the visual powers with those of the other senses, like the anterior crus of the fornix in mammalia. It is the only general combining medium in the place of the great commissure and fornix. It associates the parts of its corresponding hemisphere concerned in sensitive functions, but the two hemispheres communicate so slightly through it as to be in a great degree independent of each other, like the exterior or motive regions in mammalia.

In birds the brain and cerebellum are larger than in amphibia, but the intellect is not much higher. The brain has fewer and less extensive parts for ministering to sensation and the intellect than in mammalia generally. By far the largest portion of the brain belongs to the external or motive region, and corresponds with the greater required variety of motion. Some muscular force is necessary for respiration, but large flexors and extensors must be provided for the motions of the wings and legs. As the dorsal portion of the spine is so fixed, there is a great saving of voluntary muscular power, which would otherwise have been necessary for keeping it sufficiently firm in accordance with the vigorous motions of the limbs. Therefore, although the motive region is in a great degree the largest, the entire dimensions of the brain must have been further increased, as in mammalia, if the spine had throughout permitted corresponding motions, and the actions of the limbs had depended on its assistance through muscular power for their support in the several modes of progression.

PLATE XXII.

Fig. 2

Fig. 1

Fig. 3

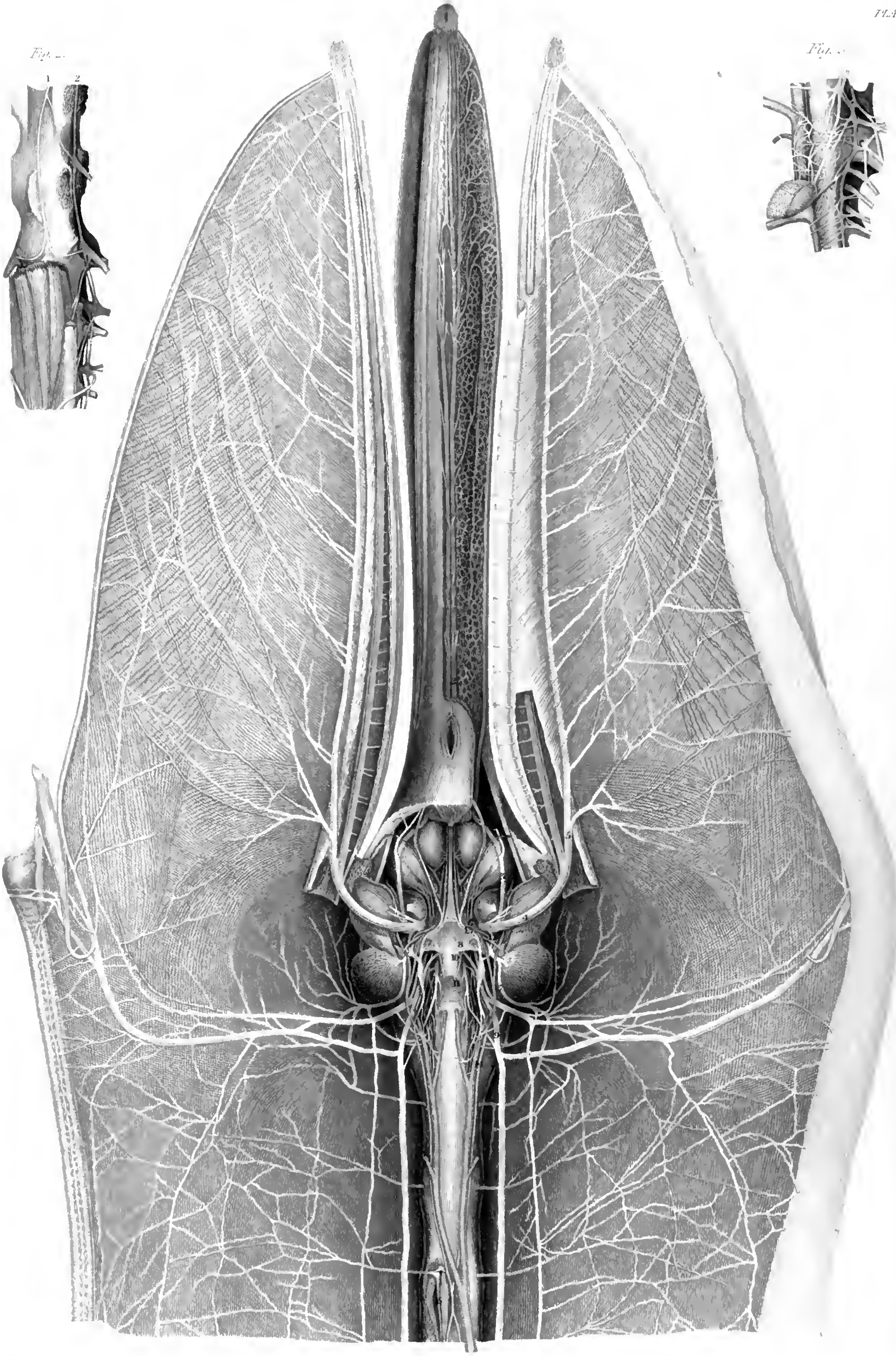

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PLATE XXI.

THE PELICAN.

(PELECANUS ONOCROTALUS.)

Fig. I.

In making the preparation from which this plate was taken, the skin, the œsophagus, the pharynx, and lower jaw, were divided in the median line, and turned outwards; the lining membrane of the œsophagus and pharynx were carefully separated, and the nerves partially traced, portions of the lower jaw and of the upper were then removed, for showing their continuations. In all similar subjects where the parts are very thin, after a slight separation of some of them, the subject should be immersed in water for a few hours, and afterwards kept in very weak spirits during the progress of the dissection, for if it should be at first placed in alcohol, the nerves and membranes become so impacted on each other, and so soon dry on exposure to the air, as to make the dissection very unsatisfactory.

1. Third nerve.
2. First trunk of the fifth, sending off branches to the palatine or inferior surface of the upper jaw, and at a short distance from the beak giving off a large branch to distribute filaments on the superior surface of the anterior portion

of the upper jaw, some of which communicate with others from the second trunk.

3. Second trunk of the fifth, giving a large branch to the upper eyelid, and branches to the palate, then passing at the exterior margin of the upper jaw, and giving off numerous filaments to the superior surface of this part.

4. Third trunk of the fifth, giving branches to the muscles of the jaw, and sending off the large branch, 5; it then passes within the jaw, distributing filaments through perforations to terminate on the membrane covering the exterior of this part; at some distance from the beak it gives off a very large branch, which is still continued within the jaw, but near the beak it passes through a foramen, and divides into two branches to terminate on the mylo-hyoideal muscle.

5. Large branch of the third trunk of the fifth, giving off numerous branches, which divide into two planes, one to terminate on the mylo-hyoideal muscle and the membrane lining the fauces, the other on this muscle and the skin.

6. Sixth nerve, giving a branch to the abducent muscle and that of the nictitating membrane.

7. Hard portion of the seventh; it gives a branch to the digastric muscle, and then becomes connected with several cervical nerves, which terminate on the skin and cutaneous muscle, and communicate with branches of the conjoined glosso-pharyngeal, par vagum, and ninth.

8. Glosso-pharyngeal nerve, on which the ganglion of the sympathetic is situated: it becomes united with the trunk of the par vagum, and then divides into numerous branches for the muscles of the fauces, the pharynx, and trachea, a larger one accompanying the long muscle, resembling the genio-hyoideal or hyo-glossal, as far as the beak; many filaments communicate with branches of the conjoined hard portion of the seventh and spinal nerves.

9. Trunk of the par vagum; it becomes united with the glosso-pharyngeal and ninth, and sends off a large branch to join the one proceeding from its previous union with the glosso-pharyngeal; it sends off another large branch to join this union; it then receives a branch of the second cervical nerve, passes down the neck, and gives the recurrent branches to the larynx and

œsophagus, also branches to join the cardiac branches of the sympathetic for the heart; it gives branches to the lungs, and then descends to terminate on the stomach, as in the crane.

10. Ninth nerve, uniting with the trunk of the par vagum.

11. Second cervical nerve, giving off a branch to join the trunk of the par vagum, and branches to the cervical muscles, and then passing outwards to join branches of the hard portion descending to the second cervical nerve, and from this to the next, &c., to terminate on the cutaneous muscle and skin.

12. Superior branch of the sympathetic nerve, communicating with the hard portion of the seventh, and then joining the second trunk of the fifth, close to its connexion with the third trunk.

13. Inferior branch of the sympathetic; it sends a branch to the palate, and one to join the branch of the third nerve, passing to the inferior oblique muscle of the eye; it gives filaments to Harder's gland, and there joins the first trunk of the fifth. The nerve from which this and the superior branch proceed appears like the trunk of the glosso-pharyngeal.

14. A branch of the sympathetic nerve, proceeding from the inferior part of the ganglion to accompany the carotid artery to the bifurcation, where it joins that of the other side; it gives off filaments to branches of the artery, and to communicate with the prolongation of the sympathetic accompanying the vertebral artery, at the bottom of the neck it dips down between the anterior cervical muscles, and divides into two branches to join the last cervical ganglion but one on each side.

15. Prolongation of the sympathetic, accompanying the vertebral artery, and communicating with each cervical nerve.

Fig. II.

(THE SAME.)

1. Continuation of the sympathetic, accompanying the carotid artery, and dividing into two branches to join the last cervical ganglion but one on each side.
2. Continuation of the sympathetic accompanying the left vertebral artery; one filament connecting it with the branch accompanying the carotid artery has been preserved.

Fig. III.

(THE SAME.)

This shows the connexion between the inferior splanchnic plexus of the sympathetic and the renal capsule, and between this and the ovary.

PLATE XXII.

Fig. 1

Fig. 2.

Fig. 3.

Fig. 7.

Fig. 5.

Fig. 6.

Fig. 8.

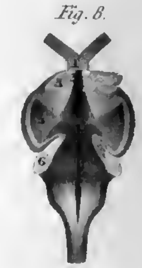

Fig. 9.

Fig. 4.

Fig. 10.

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PLATE XXII.

THE GOOSE.

(ANSER PALUSTRIS.)

FIG. I.

a. SUPERIOR oblique muscle of the eye. *b.* Adductor muscle. *c.* Attollent muscle. *d.* Brain. *e.* Cerebellum.

1. Olfactory nerve, spreading round the superior part of the Schneiderian membrane, and thus forming an appearance of a hollow ganglion.
2. Pathetic nerve to the superior oblique muscle.
3. First trunk of the fifth; it passes close to the olfactory nerve, and appears to be connected with this, and gives filaments to the Schneiderian membrane; it meets its fellow on the floor of the nose, and then gives off a large branch to the exterior of the upper jaw near the beak, and another to divide on the palate, and send branches through perforations in the bone to the membrane covering the beak.
4. Second trunk of the fifth, giving branches to the posterior part of the beak and palate.

Fig. II.

(THE SAME.)

In the goose all the muscles concerned in the motion of the jaws for mastication, as well as the delicate mylo-hyoideal, and a thin square muscle arising from the side of the lower jaw, and inserted into the hyoid bone, are supplied by the fifth; and for this reason the latter muscle ought to be compared with the maxillary portion of the digastric in man. A muscle arising from the head and inserted into the angle of the jaw, and compared with the upper belly of the digastric, and another analogous to the stylo-hyoideal, arising from the lower jaw, and inserted into the side of the hyoid bone, are supplied by the hard portion of the seventh, which also communicates with the cervical nerves given to the cutaneous muscle of the face and neck. The long muscle on the side of the trachea, the hyo-laryngeal, the trachea, the hyo-glossal, and lingual, are supplied by the ninth; another muscle arising from the lower jaw, and connected with the posterior part of the hyoid bone, is supplied by the glosso-pharyngeal, whilst the rest of this nerve terminates on the surface of the tongue, reaching as far as the tip. The following muscles have been denominated according to the supply of corresponding nerves in mammalia.

a. Mylo-hyoideal muscle. *b.* Maxillary portion of the digastric muscle. *c.* Superior portion of the digastric muscle. *d.* A muscle that may be compared with the stylo-hyoideal. *e.* Cerato-maxillary muscle, arising from the lower jaw, and then surrounding the cornu of the hyoid bone. *f.* Hyo-glossal muscle. *g.* Lingual muscles. *h.* Hyo-laryngeal, or tracheal muscle.

1. Branch of the third trunk of the fifth to the mylo-hyoideal muscle, and another muscle, arising from the side of the lower jaw, and inserted into the hyoid bone; this muscle is analogous to the maxillary portion of the digastric.

2. Hard portion of the seventh; it communicates with the sympathetic, and sends branches to muscles analogous to the superior belly of the digastric and the stylo-hyoideal, and communicates with a branch of the second cervical nerve, to terminate on a cutaneous muscle connected with the external auditory meatus and the posterior part of the face, and upper part of the neck; after having communicated with the second cervical nerve, it appears to pass down and communicate with the third, and then with the fourth; and although the fourth communicates with the fifth, this with the next, and so on, it cannot be determined that it is through the continuation of the hard portion of the seventh.

3. Glosso-pharyngeal nerve; it gives a branch to the pharynx and œsophagus, and muscles connected with the glottis, and then passes near the lower jaw to the hyoid bone, gives a branch to the cerato-maxillary muscle, arising from the lower jaw and surrounding the posterior part of the hyoid bone, and then passes on the surface of the tongue, distributing filaments as far as the tip, and communicating with branches of the nerve of the opposite side.

4. Trunk of the par vagum.

5. Ninth nerve; it gives a branch to the hyo-laryngeal muscle, placed at the side of the trachea, and sends a large branch forward to give a branch to the hyo-glossal and lingual muscles.

6. Second cervical nerve, communicating with the hard portion of the seventh, and distributed on the cutaneous muscle and skin of the face.

Fig. III.

(THE SAME.)

a. Inferior oblique muscle of the eye. *b.* Depressor. *c.* Adductor. *d.* Muscle of the nictitating membrane. *e.* Abductor. *f.* Optic lobes. *g.* Oblong medulla. *h.* Cerebellum.

1. Optic nerve.
2. Third nerve, giving branches to the inferior oblique muscle, the adductor, levator, and depressor.
3. A branch of the third nerve, receiving a filament from the first trunk of the fifth to form the ciliary nerve.
4. First trunk of the fifth continued to the palate; it passes through the orbit, and appears to be connected with the olfactory nerve at the nose; it gives filaments to the Schneiderian membrane, and then meets its fellow close on the floor of the nose, and divides to distribute many filaments on the palate, and send some through perforations in the bone to the covering of the beak.
5. Second trunk of the fifth, given to the posterior part of the beak and palate.
6. Third trunk of the fifth cut short; a part having a separate origin from that of the ganglion, somewhat similar to the muscular portion of mammalia, is seen passing to it; it gives branches to various muscles of the jaws connected with the omoid and square bones, and then enters a canal in the jaw, and sends filaments through perforations in the jaw to the masseter and other muscles, and to the teeth and membranous covering of the lower jaw, and particularly the beak.
7. Sixth nerve, given to the abductor muscle of the eye, and the muscles of the nictitating membrane.
8. Hard portion of the seventh; it enters a foramen anteriorly to the auditory nerve; it passes downwards and backwards on the outer side of the vestibule, and escapes at a foramen in the posterior part of the external auditory meatus, after having communicated with the sympathetic nerve.
9. Auditory nerve.
10. Glosso-pharyngeal nerve.
11. Trunk of the par vagum.
12. Ninth nerve.
13. First cervical nerve.

Fig. IV.

(THE SAME.)

a. Crus of the brain, proceeding from the anterior lobe, part of which has been removed. *b.* Optic lobe, continued to the optic commissure. *c.* A process from the thalamus to the optic commissure. *d.* Lateral lobe of the cerebellum.

1. Optic nerve.
2. First trunk of the fifth.
3. Second trunk of the fifth.
4. Third trunk of the fifth.

Fig. V.

(THE SAME.)

A separation has been made at the median line of the hemispheres of the brain for showing the radiated septum.

Fig. VI.

(THE SAME.)

On cutting off a small portion of the summit of the brain on each side near the median line, a narrow ventricle, deep at the internal part, extends nearly to the base

of the hemisphere; over the third ventricle the partition between the two lateral ventricles is composed of two layers of radiated medullary fibres, and is very similar in form to the septum lucidum, and at its posterior or broader part diverges from the middle line, and leaves a triangular space. The posterior wall, which is a continuation of the septum, is very thin, and is extended over the third ventricle like the former; pillars from the anterior part pass down, and are inserted into, or joined with, the optic commissure. The part of the hemisphere projecting into this cavity, is termed the striated body. At the anterior part there are two cords proceeding from the hemispheres, and passing just above the optic tracts, which are the crura of the brain. Beneath the lateral ventricles there is a substance on each side connected by a commissure, and these appear to be the thalami, between which the third ventricle is situated. The third ventricle communicates with a cavity in each of the optic lobes, and then passes under the cerebellum to the calamus scriptorius. It appears as if the optic lobes and thalami existed, but are more confounded with each other than in mammalia, and thus a different conformation of parts is produced.

1. Olfactory nerve. 2. Striated body. 3. Radiated septum, forming the middle boundary of the lateral ventricle. 4. Lateral ventricle; the anterior part is rough, from which much of the striated body has been removed.

Fig. VII.

(THE SAME.)

1. ANTERIOR pedicles of the radiated lamina. 2. Crus of the brain. 3. Portion of the thalamus extending to the optic commissure. 4. Thalamus of the optic nerve. 5. Cavity of the optic lobe. 6. Ventricle in the cerebellum. 7. Lateral lobe of the cerebellum. 8. Crus of the cerebellum. 9. Fourth nerve.

Fig. VIII.

(THE SAME.)

1. Optic tract connected with the thalami, optic lobes and pedicles of the radiated lamina.
2. Pedicles of the radiated lamina or septum of the lateral ventricles.
3. Crus of the brain; on the right side it has been more separated from the optic tract than on the left.
4. Third ventricle continued to the calamus scriptorius; its sides have been rather too much separated, and thus at the bottom the joining threads of the two sides have been exposed, and some of these have been delineated in the engraving.
5. Ventricle in the optic lobe.
6. Cut edge of the cerebellum.

Fig. IX.

(THE SAME.)

1. Continuation of the optic lobe to the optic tract.
2. Continuation of the thalamus to the optic tract. The optic lobes and thalami are so connected as to make it difficult to define the limits of each, and the precise extent of the origin of the optic tract from each of these parts.
3. Continuation of the crus of the brain towards the oblong medulla; a portion of the optic tract has been removed for the purpose of showing it.

Fig. X.

(the same.)

This shows the lumbar ventricle of the spinal cord.

PLATE XXIII.

Fig 1

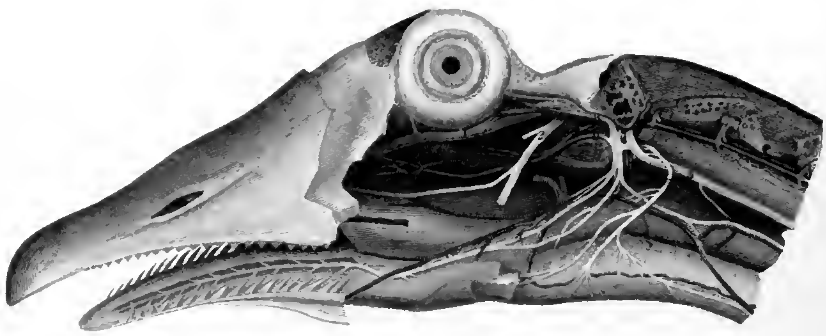

Fig. 4.

Fig. 5.

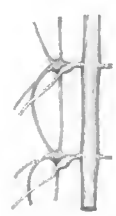

Fig. 6.

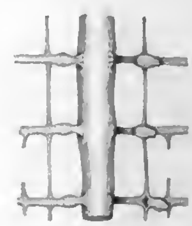

Fig. 2.

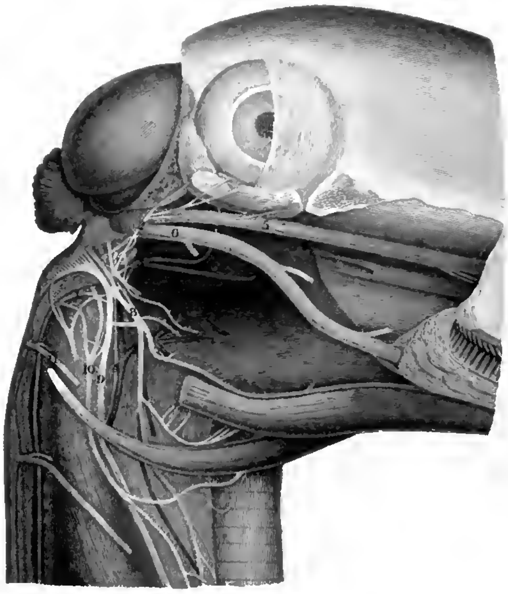

Fig. 3.

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PLATE XXIII.

THE SYMPATHETIC NERVE OF THE GOOSE.

(ANSER PALUSTRIS.)

Fig. I.

1. Second trunk of the fifth nerve.
2. Third trunk of the fifth nerve.
3. A branch of the hard portion of the seventh passing to the superior branch of the superior ganglion of the sympathetic.
4. A branch of the glosso-pharyngeal nerve, which has supplied the cerato-maxillary muscle, and rejoined the continuation of the nerve, which supplies the surface of the tongue in its course, and towards the anterior part communicates freely with the nerve of the opposite side.
5. Trunk of the par vagum.
6. Ninth nerve.
7. Prolongation of the sympathetic nerve, accompanying the vertebral artery. It proceeds from the superior ganglion, which is placed between the glosso-pharyngeal nerve and the par vagum. Another branch passes down the neck with the carotid artery, and although it appears to be principally for supplying the bloodvessels, it corresponds with the prolongation on the anterior part of the neck in other classes.

8. Superior branch of the sympathetic passing from the superior ganglion; it accompanies a large artery to the orbit, and is continued forward to communicate with the second trunk of the fifth, and give filaments about the lachrymal gland. In the pelican, the branch proceeding to the lachrymal gland appears to be derived rather from the second trunk of the fifth, after this has received the branch of the sympathetic.

9. Inferior branch from the superior ganglion of the sympathetic, passing at the base of the skull with the internal carotid artery; it receives a branch 3, from the hard portion of the seventh, and then goes forward, and sends one branch into the orbit to Harder's gland, and communicates with the first trunk of the fifth; it sends another to the posterior part of the palate and nose, and to communicate with the second trunk of the fifth.

Fig. II.

THE SYMPATHETIC NERVE OF THE SWAN.

(CYGNUS OLOR.)

1. Prolongation of the sympathetic; after leaving the canal of the vertebral artery it communicates with the ninth, and then with the superior ganglion which lies between, and is connected with the trunk of the par vagum and the glosso-pharyngeal, at their exit from their osseous canals, and is placed partly upon the latter nerve.

2. Superior branch of the superior ganglion of the sympathetic; it passes with a large artery to the orbit, and communicates with the second and third trunks of the fifth, and with the hard portion of the seventh; it gives a branch to the lachrymal gland and conjunctive membrane; it sends one branch beneath the slender bone of the tympanum to join the inferior branch 3, close to the glosso-pharyngeal nerve.

3. Inferior branch of the superior ganglion of the sympathetic, passing with the internal carotid artery: it begins by a branch passing upwards from the glosso-pharyngeal nerve; it receives a branch from the superior branch 2, passing beneath the slender bone of the tympanum; it is continued onwards and receives a branch from the hard portion of the seventh; it then divides into two branches, one passes into the orbit to the gland of Harder, after sending a filament to the first trunk of the fifth, the other passes to the palate and nose.
4. Descending branch from the superior ganglion of the sympathetic accompanying the carotid artery to the bottom of the neck, and communicating several times with its fellow.
5. Second trunk of the fifth.
6. Third trunk of the fifth.
7. Hard portion of the seventh.
8. Glosso-pharyngeal nerve.
9. Trunk of the par vagum.
10. Ninth nerve.
11. Prolongation of the sympathetic, communicating with a spinal nerve; it passes down in a canal with the vertebral artery, and communicates with all the other cervical nerves. The posterior trunk, or division of each cervical nerve, is not joined to the sympathetic, but only the anterior; and on this, after it has left the spinal ganglion, the sympathetic ganglion is formed, from which a nerve passes, giving some filaments to the muscles on the anterior part of the neck, and then terminating on the skin. The posterior trunk or division terminates on the posterior part of the neck. The division into an anterior and posterior trunk is the same in the crane; the anterior communicating with the sympathetic, and being distributed in the same manner as in the swan, and the posterior trunk on the muscles and skin at the posterior part of the neck.

Fig. III.

CONNEXIONS OF THE NERVES IN THE NECK OF THE CRANE.

(ARDEA CINEREA.)

1. Sympathetic nerve passing up in the canal with the vertebral artery.
2. Glosso-pharyngeal nerve: it soon becomes united with the ninth; branches are then given to the muscles and other parts, which receive them from similar, but separate, nerves in the goose.
3. Trunk of the par vagum; it descends so close to the spinal nerves, that it is difficult to determine whether its adhesion to these be not through nervous matter; but after a careful examination, it appeared most probable that it was by mere expansions of neurilema.
4. Ninth nerve.
5. Hard portion of the seventh, giving a branch to the digastric muscle, and communicating with the second cervical nerve, the par vagum, and glosso-pharyngeal near the junction of this with the ninth, and sending a branch to terminate on a thin slip of muscle, that may be analogous with the stylo-hyoideal in the goose; after it has communicated with the second cervical nerve, it is connected also with the third, and several more in passing down the neck, but at length cannot be recognised; in this course it gives filaments to the long cutaneous muscle.
6. A branch of the third trunk of the fifth passing out of the jaw; it is similar to the small one in the goose 1, Fig. 2, Plate XXII., and the larger one in the pelican 5, Fig. 1, Plate XXI.

Fig. IV.

THE GOOSE.

(ANSER PALUSTRIS.)

Part of the cervical portion of the sympathetic nerve is represented, showing a ganglion connected with the anterior trunk of each spinal nerve, and not with the posterior.

Fig. V.

(THE SAME.)

This figure shows the thoracic portion of the sympathetic, and the connection of its ganglia with those of the spinal nerves.

Fig. VI.

(THE SAME.)

The sympathetic nerve is represented in connexion with nerves entering the axillary plexus, and as having an equal communication with the anterior and posterior bundles.

PLATE XXIV.

THE THORACIC PORTION OF THE SYMPATHETIC NERVE IN THE LEFT SIDE OF THE SWAN.

(CYGNUS OLOR.)

FIG. I.

1. SYMPATHETIC nerve: at the very bottom of the neck it emerges from the vertebral canal, and is continued through the thorax, and near its entrance into this begins to form a double communication with the spinal nerves, one branch passing over the other underneath the head of each rib. The ganglia are connected with the ganglia of the six dorsal nerves after the first, but with the cervical and lumbar nerves, and not the ganglia. On separating the anterior and posterior bundles of one of the largest spinal nerves, the sympathetic appeared to communicate quite as much with one as the other.
2. Branches from the first thoracic ganglion to communicate with the pulmonary branches of the par vagum, and accompany the large bloodvessels to the heart.
3. First large splanchnic nerve; it is given off by the thoracic portion of the sympathetic, and after communicating with that of the right side on the cœliac artery, the branches proceed from the union along the branches of

Fig. 1.

Fig. 2.

Drawn by West.

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this artery to the liver, the upper portion of the small intestines and the gizzard, and on this organ communications take place with branches of the par vagum.

4. Second large splanchnic nerve formed by branches from the prolongation and several thoracic ganglia, it corresponds more particularly with the splanchnic nerve of mammalia; it passes to the renal capsule, with which it becomes intimately united, and then distributes its branches to the small intestines, and the ovaries or testes.

5. Recurrent branch of the par vagum.

6. Union of each trunk of the par vagum passing to the gizzard. The par vagum, after having communicated with the sympathetic, the glosso-pharyngeal, and the ninth, passes down the neck, accompanied by the internal jugular vein: on the right side it extends over the arch of the aorta, and sends the slender recurrent nerve round this vessel to the œsophagus; it then gives branches to the lungs, and passes over the right branch of the pulmonary vein to the left side to join the left trunk, after giving filaments to the pulmonary artery and vein. The left trunk near the bifurcation of the trachea sends up its slender recurrent nerve, which gives filaments to the trachea, but its principal part terminates on the œsophagus; it gives filaments to the lungs, and sends a large branch down on the œsophagus to terminate on the enlarged part of this canal near the gizzard; it then passes over the pulmonary vein after having given filaments to this and the pulmonary artery; it is then joined by the right trunk, and one cord is thus formed, which passes down on the front of the œsophagus to terminate on the gizzard, after it has communicated with filaments from the splanchnic nerves accompanying the cœliac artery.

Fig. II.

THE NERVES OF THE STOMACH OF THE CRANE.

(ARDEA CINEREA.)

After the par vagum has given numerous branches to the trachea and lungs, and the large vessels of the heart, it sends off the recurrent on each side to give branches to the œsophagus, to the lower larynx and its muscles; it then sends a branch downwards on each side of the stomach; the rest of each trunk becomes joined in front of the œsophagus, passes on the stomach as far as the cardiac extremity, and sends filaments to communicate with branches of the splanchnic nerve as well as the one passing on the cœliac artery.

1. Right trunk of the par vagum.
2. Recurrent branch of the same.

Drawn by West

Engraved by Finden

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PLATE XXV.

THE NERVES OF THE SWAN.

(CYGNUS OLOR.)

The branches pointed out in the two preceding plates will not be particularly noticed in this.

1. First large splanchnic nerve.
2. Second large splanchnic nerve: after this has been given off, the sympathetic passes downwards and communicates with the spinal nerves; it sends some branches upwards to communicate with others from the splanchnic nerves, and give branches to the kidneys and several to the meso-colon, many of which advance forward and form an arch near to that of the meso-colic artery, which at the superior part communicates with the splanchnic nerve, and gives branches to the intestines and others to the delicate peritoneum.
3. The sympathetic communicates freely with the anterior trunks of most of the spinal nerves within the pelvis; these form several large cords, which pass downwards to the muscles and other parts connected with the cloaca and skin.
4. Spinal cord; it passes down of nearly the same size; about the middle of the neck it is rather smaller, and at the lower part begins to increase, and becomes still larger about the middle of the portion giving off the nerves to the axillary plexus; it then gradually diminishes, and a great part of the

thoracic portion continues of nearly the same size as the upper part of the cervical; towards the loins it increases again, and becomes most enlarged about the middle of the portion giving off the nerves to the lower extremities. A little above and below this part there is a separation of the two posterior halves of the cord at the ventricle, which is covered only by membrane; the spinal cord begins to diminish again, and becomes gradually less as it approaches the extremity of the tail. In the dorsal and lumbar portions, where no motion is allowed, the cord fills the spinal canal, and in many parts is covered closely by a thin plate of vitreous bone. The anterior and posterior bundles of each nerve are of nearly the same size; and in one of the largest nerves, the anterior bundle could not be so clearly separated from the ganglion as in man, neither in the turtle. The cervical nerves are very numerous, each of them is divided into an anterior and posterior trunk; the anterior is given to the muscles and the skin, and the posterior principally to the muscles. The dorsal, after giving filaments to the intercostal muscles and the rudiment of the diaphragm, pass to the skin of the side; the lumbar and some of the sacral form the nerves of the lower extremity; and the rest, to the termination of the spinal cord, are given to the muscles and skin of the cloaca and tail. In the pinion very distinct little muscles are observed for giving motion to the quills, and thus form a variety of the cutaneous muscle.

5. First of the three cervical nerves, which, together with the first dorsal, form the axillary plexus. The two preceding cervical nerves communicate together, and then with the first entering the plexus, and are distributed on the muscles at the posterior part of the scapula corresponding with the trapezius, the levator of the scapula and rhomboid, and on the skin. Several branches from the plexus are given to the pectoral muscles and that resembling the great serrated.

6. Circumflex nerve; it gives a branch to a muscle analogous to the broadest muscle of the back, and is then distributed on the deltoid.

7. Internal cutaneous nerve, descending, at the inner side of the humerus, to the skin.

8. Spiral nerve; it gives branches to the teres and scapular muscles; it sends branches to the internal brachial muscle and the extensor corresponding with the triceps. In passing behind the fore-arm it gives a branch to supply the skin; at the back of the ulna it gives a branch to the radial muscle, and a muscle corresponding with the short supinator, to the external ulnar, and the other muscles analogous to the extensors of the wrist and fingers, and is then continued close to the interosseous ligament to the skin and other parts at the back of the pinion. A similar branch was traced in the pelican to the back of the pinion; it there divided into two branches, one to be distributed on the skin at the edge of the thumb, the other to the muscles and skin at the middle part as far as the extremity of the finger.
9. Median nerve passing with and giving branches to the biceps muscle.
10. External cutaneous nerve arising from the median, and descending to the skin on the outer side of the fore-arm.
11. A branch of the median corresponding with the ulnar; it passes over the inner condyle of the humerus, and gives filaments to the skin of this part, and to the internal ulnar muscle; it sends a branch down the fore-arm on the outer side of this muscle to the skin throughout the outer edge of the pinion; another branch passes underneath, and then at the inner side of the internal ulnar muscle, to terminate on the palmar face of the pinion. In the pelican a branch corresponding with the last is conveyed underneath, and adhering to the tendon of a similar muscle to supply the muscles and skin of the palmar face of the pinion, and communicate there with a branch of the median.
12. Continuation of the median nerve; it sends a branch under the head of one of the pronators of the radius and gives filaments to this muscle, and the other pronator of the radius, and passes down to the skin as far as the pinion; another branch passes behind these muscles and reaches the ulnar side of the inner pronator of the radius, and passes down the fore-arm to the pinion and divides into two branches, to be distributed on the thumb and fore-finger. In the pelican, this branch is divided in the same manner, one supplying the muscles of the thumb, and skin; the other, after communicating with the ulnar, is extended along the fore-finger to the skin.

13. Anterior crural nerve: it is formed by the first, second, and third lumbar nerves, and is accompanied by a small artery; it is given to the muscles which are in the place of the gluteal, the tensor of the fascia of the thigh, the straight muscle, the external and internal vast, and the crural, and sends off a slender branch, the saphenus, to be joined by another from the obturator to pass down on the inner side of the leg.

14. Obturator nerve: it arises from the second and third lumbar nerves, and after giving off the branch to join the saphenus, terminates on the obturator and pectineal muscles.

15. Sciatic nerve: it arises from six nerves below the third lumbar, and is accompanied by the femoral artery into the thigh; after giving branches to the adductor and the flexors at the back of the thigh, which are in the place of the biceps, the semimembranous and semitendinous, it passes down and divides into the posterior tibial and peroneal nerves; the posterior tibial divides into two portions.

16. One division of the posterior tibial nerve: it gives branches to several muscles corresponding with the inner part of the gastrocnemius, the posterior tibial and the flexors of the toes, and sends one down to the skin at the inner side of the leg.

17. Another division of the posterior tibial nerve given to the heads of muscles forming the outer part of the gastrocnemius.

18. A branch of the peroneal nerve passing down the leg behind the tendons towards the outer malleolus, and from thence to be distributed on the sole of the foot. The course of this corresponds with that of the posterior tibial in mammalia.

19. The peroneal nerve: it passes to the outer side of the leg and gives branches to the muscles, corresponding with the peroneal, the anterior tibial, and the extensor of the toes.

20. The anterior tibial nerve of the peroneal: it passes between the peroneal muscle and the extensor of the toes, and under the annular ligament, and gives a branch to the inner side of the first or inner toe, and another to divide for the outer side of the first toe and the inner side of the second.

21. Continuation of the peroneal nerve: it becomes superficial about the lower part of the leg, and passes over the annular ligament at the ankle, and then between the tendons of the second and third toes, and divides for the outer side of the second and the inner side of the third; another slender branch passes from between the muscles on the outer side of the leg, and is distributed on the skin about the outer ankle.

MAMMALIA.

THE BRAIN.—The brain is strongly surrounded and supported by the dura mater; it is closely invested by the pia mater, by which its bloodvessels are conducted, and it is more or less loosely enveloped by the arachnoid. The dura mater forms a sheath for the nerves at their exit, and then becomes very thin and apparently lost on the neurilema; the pia mater is continued on the nerves, and forms the connection of the fibrils and a support for the vessels; the arachnoid only loosely surrounds some nerves to their exit through the foramina.

The brain is composed of two different substances, as in man, which have a similar arrangement, but the white matter appears to be greater in proportion to the grey. The number and breadth and depth of the convolutions vary in animals of the same kind, and those of the two hemispheres, as in man, do not always correspond; generally they are separate, and aggregated on the surface, but sometimes combined, as in the hedgehog and rat, also more or less even in simiæ. The shape of the brain varies, being rounded or oval, or more or less narrow anteriorly or posteriorly, or rising to a greater height from the base. The posterior parts of the hemispheres cover the cerebellum in simiæ, but in some not entirely, as in the porpoise, jaguar, dog, and fox; in others still less, as in the horse and sheep; not at all in the hedgehog; whilst in the rat, a portion of the quadrigeminal bodies is exposed. The superior parts of the hemispheres in some animals faintly exist, but in all are generally much smaller than in man, and particularly in their proportion to the oblong and spinal medulla and the nerves; their greater or less separation depends

upon the size of their superior parts, and on the same circumstance the depth at which the great commissure is situated, as well as its dimensions. The structure of the great commissure is nearly the same as in man, but when the brain is very small, it appears on division almost like a line. In the porpoise it is thin, the raphe is distinct and particularly the transverse fibres.

The dimensions of the lateral ventricle and the transparent septum vary with the extent of the great commissure. The transparent septum is generally thicker and narrower than in man, and very small in rodent animals. In some, as the horse and sheep, the anterior horn is continued into the cavity of the great tubercle of the olfactory nerve. In simiæ, in the place of the posterior horn, there are two small angular excavations, and a very slight eminence connected with the superior and posterior part of the great hippocampus. In simiæ and the porpoise the body of the fornix is thin and small, it is unattached and placed over the third ventricle. In many instances the body of the fornix is much larger in proportion to the size of the ventricles than in man, and then it conceals the thalami. In the horse and sheep its anterior pillars are connected with the great commissure, and become inserted into the anterior angle of each thalamus, and into the combination between the optic commissure, the eminence surrounding the infundibulum and the mammillary body; its posterior pillars have not a loose edge, but become involved in the hippocampus. The inferior horn generally winds downwards and forwards, as in man, and contains the great hippocampus and the continuation of the choroid plexus. In the porpoise the choroid plexus is flat, its inner border is a congeries of minute vessels ramified from longitudinal ones running on the exterior border; the plexus of each side communicates underneath the fornix. The great hippocampus in simiæ is continued down nearly as far as the projecting point of the middle lobe, and appears to be solid, and combined with the convolutions at the posterior and inner margin of the lobe, and is not seen at the base of the brain, as in the horse, goat, and others, but in these its parietes are thin, and connected in the ventricle with the inner surface of the prominence forming the origin of the olfactory nerve, on the lowest part of which there are two small eminences; its concave or outer surface lies partly on the thalamus, and partly on the

optic tract, and at the base of the brain its conjunction with the large prominence giving origin to the olfactory nerve is again seen. In the rat, the great commissure is very small, but the fornix and hippocampus are so large as to occupy nearly the whole lateral ventricle.

The striated bodies and thalami are nearly the same as in man; they are small in the porpoise in proportion to the size of the brain; in all an anterior, posterior, and soft commissure exist. The tænia, or medullary line, is situated between the striated body and thalamus.

The pineal gland is found in the same situation as in man: it varies in shape, and has processes extending forwards to the thalami, and backwards to the nates. There is a considerable variety in the proportion of the nates and testes to each other. In the baboon, the nates are much larger than the testes; in other simiæ, the nates are nearly round, but rather flattened at the top, and not much larger than the testes. In the pig, and in herbivorous animals, the nates are much larger than the testes, as in the sheep and horse, and in the carnivorous the testes are the largest. In the jaguar, the common cat and dog, the surface of the nates is broader and flatter than that of the testes, but these are more prominent, and extend further laterally, and the geniculate bodies are large. In the rat, the nates are longer, but less broad than the testes. In the porpoise the nates are red, the testes white and larger than the nates.

The striated body is large throughout the class in proportion to the brain. In the horse and ox it is long, but not quite so wide at the anterior part as in man. On removing the grey matter and the white fibres passing through it, the internal oval receptacle is left; it is less capacious and more shallow than in man, and on removing the low convolutions at the bottom of the fissure of Sylvius, or in their corresponding place, a similar cavity remains as in man, but not so extensive. The anterior commissure becomes connected with the anterior crus of the fornix, and on leaving it passes towards the middle lobe of the brain in simiæ as in man to the group of low convolutions forming the island; it divides, when one portion becomes connected with the tract of the low convolutions at the anterior lobe of the brain, whilst the other is attached to the more posterior of the same group at the middle lobe. In the

horse and ox, the anterior commissure, after leaving the anterior crus of the fornix, also passes downwards and outwards, and divides into two portions, which approach a group of low convolutions in the exterior of the brain in a similar situation, but not covered by others; one portion of it joins the tracts of the more anterior of the low convolutions, the other joins the tracts of the same group near the middle of the exterior surface of the brain.

The thalamus varies in extent in different animals, in some degree according to the size of the brain. Its surface is less extensive, in proportion to the optic nerve and eye, in many animals, than in man. In the horse, which has a large brain, it approaches that of man, but is shorter and sooner terminates in the optic tract; it is also narrower, and not so regularly oval; anteriorly it receives the true visual tract. It is connected with the anterior portion of the body of the fornix, with half of the mammillary body, the optic commissure and the eminence surrounding the infundibulum, and thus a thicker and more intimate combination is formed between those several parts than that in man. The anterior portion of the thalamus is intimately connected with the true visual tract; the middle of its under surface is connected by fibres with the involuntary tract; its posterior surface then gains some increase from the sensitive tract and from the quadrigeminal and geniculate bodies. It becomes the optic tract which receives threads from the sensitive tract spread beneath the epithelium in the inferior horn of the lateral ventricle, and is then continued to the optic commissure. The two thalami are combined by grey fibres at the large rings placed at the median sides, by which a communication is kept up similar to that by the soft commissure in man. The posterior part of each thalamus is united by the posterior commissure.

The base of the brain is very different from that in man: in simiæ, the anterior lobes are very small in comparison with the middle ones, but they are separated by the fissure of Sylvius; in the porpoise there is also a separation. In many animals there is no division into lobes, and very few convolutions are apparent. In simiæ, the origin and size of the olfactory nerves correspond, in a considerable degree, with the same in man, but in many instances the origin extends over a great part of the

base of the brain; posteriorly and internally it is connected with the inferior portion of the hippocampus; anteriorly, it occupies much of the base of the anterior lobe, and very little more than the large bulbous extremity of the nerve is detached. In the porpoise there is no appearance of the olfactory nerves or of the continuations of the great hippocampus. The commissure of the optic nerves is generally less broad than in man. The crura of the brain in the horse are large and appear long, as the small size of the annular tubercle leaves them more exposed; they are longer in the goat and sheep than in the dog and fox; the origin of the third nerve is nearly the same; the cribriform lamina hardly exists, and the mammillary eminences vary in appearance, being frequently, as in the horse and others, more like a single indistinct prominence. The pituitary gland is usually large, especially in the horse, and appears to be composed of two substances, which resemble the cerebral matter and the renal capsule.

The cerebellum varies in form and size, but the lateral lobes, however small, may generally be compared with those of man; and the middle, however large, with the vermiform processes. But it varies in the greater or less proportion of the lateral lobes to the middle, generally in the less; in the porpoise, however, the lateral lobes are nearly as large, and the middle as small, as in man; and in many instances it varies in the presence of lateral lobules attached at the outer side of the inferior portion of the lateral lobes, as in the simiæ and the rat, and these correspond with the rudiments of lateral lobes in birds, and are fitted into similar cavities, left by the less close adaptation of the surrounding bone to the semicircular canals. It varies in the different shape of the lobes, in their being placed more or less backwards, and more or less underneath the posterior lobes of the brain, and consequently in having their superior parts more or less exposed. The convolutions also vary, and are thicker and shorter in some, narrower and longer in others, but there is the utmost variety in their shape and mode of aggregation for producing the general form of the whole cerebellum.

The annular tubercle is much less than in man; it however corresponds with the size of the inferior pedicle of the cerebellum, of which it appears to be the continuation, whilst the crura of the brain are more proportioned to the size of the oblong medulla: in the porpoise it is very large. In many of the mammalia a band of

transverse fibres, forming the trapezoid body, is stretched across the upper part of the oblong medulla, just below the annular tubercle; but it is much less distinct in simiæ than in the horse, sheep, dog, and others; in all of them it seems to correspond with a few of the transverse fibres of the annular tubercle in man, as the sixth and the hard portion of the seventh in some measure originate from it. In the porpoise the trapezoid body has not the same distinctness, but there is in its place a larger prominence at the upper part of the anterior pyramidal body.

The oblong medulla compared with the brain is generally of large size; most of its constituent parts in situation resemble the same in man, but may be larger, either on account of the pedicles of the cerebellum or the more copious origin of the nerves. In its general form it may be broader and thinner or thicker and more rounded. It appears broader and flatter in the horse than in the ox, also in the dog and fox than in the sheep and goat. Anteriorly it has in its centre the pyramidal bodies, then some marks of part of the origin of the larger portion of the fifth nerve, then the restiform bodies. On the posterior surface the posterior pyramidal bodies and the calamus scriptorius are seen, and on each side the continuations of the restiform bodies.

The anterior pyramidal bodies at their upper part are connected with the trapezoid bodies; the more external fibres appear to be continued down on the surface towards the spinal cord, and the more inner fibres to decussate or cross each other. On removing the subjacent structures the decussating inner fibres may be seen passing horizontally backwards; near the median line they are coarser, but become finer as they tend to the lateral part of the oblong medulla, where they meet similar ones proceeding from the inner or thicker portion of the restiform body. Superiorly the fibres communicate further with the transverse ones of the annular tubercle derived from the inferior pedicles of the cerebellum.

The olivary bodies do not frequently appear distinct in shape, as in man; they are present in simiæ, but not so prominent.

The posterior pyramidal bodies are nearly the same as in man: superiorly the rounded ends vary in different animals; in some, as the horse, they hardly present any prominence, whilst they are very distinct in the fox. The fourth ventricle and the

origin of the auditory nerves are nearly the same as in man. The ventricular cords forming the floor or surface of the fourth ventricle constitute the sensitive centres. They are partially separated by a furrow. When the epithelial covering has been removed, transverse bundles of fibres are observed, which meet at the furrow. When the anterior parts or those attached to the ventricular cords have been removed, the superficial furrow is found to form a decided ridge. The structure of this surface consists of transverse bundles of fibres intersected by longitudinal ones, so that the interstices form numerous pits for containing gray matter, affording some resemblance of a honeycomb. This structure is continued through the base of the quadrigeminal bodies and the commencement of the sensitive tracts, the thalamus, and optic tracts. At the ridge in the median line the transverse fibres meet, and communicate and probably form a connection somewhat similar to the optic commissure. This structure may be well seen in the oblong medulla of a large animal, and particularly that of the ox.

The involuntary centre is placed between the anterior and posterior surfaces of the oblong medulla; with which it corresponds, inasmuch as it is broader and thinner in the horse and narrower and thicker in the ox and man: after sending a slip into the spinal cord at the bottom of the anterior fissure, and giving origin to the accessory nerve, the par vagum, the glosso-pharyngeal, and half of the larger portion of the fifth nerve, it divides upwards into two portions, to pass underneath the thalami to their appropriate convolutions.

The restiform body is composed of an external and internal portion: the external, which is a thinner layer, is continuous with the sensitive centre on the surface of the fourth ventricle, and on being raised from the internal portion carries with it part of the origin of the auditory nerve, so that it forms an extension of the sensitive centre, and has the same cellular appearance. The more internal or thicker portion is the true continuation of the first section of the median layer of the exterior region and the anterior pedicle of the cerebellum, and of the third section of the exterior layer with the posterior pedicle of the cerebellum; it forms horizontal fibres, which leave spaces between them for the issue of nervous roots and bloodvessels; these fibres then

pass forwards to meet corresponding horizontal fibres proceeding from the more anterior tracts of the oblong medulla. By this arrangement the thicker portion of the restiform body participates in the motive functions of the voluntary tracts, whilst the external layer, continuous with the floor of the fourth ventricle, is only superimposed; any sensitive properties, therefore, which the restiform body imparts to the auditory nerve, are solely derived from this external continuation with the sensitive centre.

The preceding descriptions have been made by examining the brain from the summit and base, but for pointing out more plainly the origins of the nerves, it is necessary to begin at the median aspect in a separate hemisphere divided into three longitudinal or peripheric regions: the median, the intercedent, and the external.

The median region is connected with that of the opposite hemisphere by the great commissure, for the purposes of the intellect; in many examples of the lower kind of mammalia it is extremely limited, especially when convolutions cease to appear, so that the surface of the brain is nearly even.

The intercedent region is placed between the median and external, and on removing the superficial layer of grey matter of the striated body and the epithelium of the ventricle, the fibres appear which pass to their respective convolutions. Two of the convolutions communicate by tracts with the motive segments of the crus of the brain; one, forming the true visual, is inserted into the anterior angle of the thalamus and mammillary body; one is conveyed to the involuntary centre, in the oblong medulla; the others, in the posterior part, are conveyed in tracts, which spread out in numerous fibres on the posterior portion of the lateral ventricle and on the descending horn, for communicating with the thalamus, the optic tract and the sensitive centre formed by the ventricular cord. The same arrangement exists in simiæ, the horse and ox, whilst in man there are four larger convolutions in the place of the two in these animals anterior to the true visual, without mentioning the origin of the olfactory nerve.

The external or motive region occupies the convolutions on the outer side of the intercedent, and its tracts pass as the lower bed of fibres in the grey matter connected with the striated body. It consists of three layers, the first or inner layer occupies a

large part of this surface; it is divided into three sections, the tract of the first forms the inner part of the restiform body, after it has been joined by the anterior pedicle of the cerebellum; the tract of the second section proceeds to the oblong medulla accompanied by the tract of the second section of the third layer; the third section terminates in the median crescentic tract or belt, to pass forward round the crus, and then down the oblong medulla with the first section of the third layer. The intermediate layer has a smaller portion anteriorly, which sends its tract to the first segment of the crus of the brain for the origin of the third nerve; the larger portion sends its tract down at the posterior part of the annular tubercle to receive the tract of the first convolution of the intercedent region, and then give origin to the smaller portion of the fifth nerve, the hard portion of the seventh and the ninth. The outer layer is divided into four sections; the tract of the first is the most anterior, it passes with the median crescentic tract or belt through the crus of the brain and annular tubercle exteriorly to the outer crescentic tract or belt, and through the oblong medulla and spinal cord. The tract of the second section passes next, with the tract of the second section of the inner layer, through the crus of the brain and annular tubercle, the oblong medulla and spinal cord. The tract of the third section becomes joined with the inferior pedicle of the cerebellum, and passes to the outer side of the restiform body. The fourth section, arising from the posterior and inferior convolutions, has its tracts concentrated in the outer crescentic tract or belt to pass forward round the crus of the brain, and then descend in the median edge of the crus, the annular tubercle, and oblong medulla, to the side of the deep fissure of the spinal cord.

This description corresponds with the motive centres and tracts in the horse, and with the same in simiæ when it is stated that the median and outer crescentic tracts or belts pass by fibres through the grey matter of the striated body, before they enter the crus of the brain. The arrangement in simiæ corresponds with that in man, except the median crescentic tract or belt, which in man is double, one part of it passing with the outer crescentic tract or belt through the crus, the other part accompanying the tract of the first section of the outer layer to pass through the crus and annular tubercle.

The intermediate layer actuates muscles attached for the most part to fixed bones,

and therefore does not require any other opposing power. It gives origin to the third nerve, the smaller portion of the fifth, the hard portion of the seventh, and the ninth. The median or inner layer has been apportioned to the flexors, the first section to the inner side of the restiform body for inspiratory motions, the second for the flexors of the upper extremity; the third forming the median crescentic tract or belt, for the flexors of the lower extremity and spine. As the tendency of the joints is to flexion, and as the flexor muscles have also to be countervailed by an opposing power, a much larger force is required for the extensor muscles. The bulk of the outer layer of convolutions is therefore greater, nearly twice as much as that of those of the inner layer for the flexors. The first section of the outer layer has been appropriated to the extensors of the lower extremity; the second to the extensors of the upper extremity; the third to the outer portion of the restiform body for expiratory processes, and the outer crescentic belt to the extensors of the spine.

CEREBRAL NERVES.—The origin of the olfactory nerve varies in different kinds of animals; in simiæ it is very similar to that in man, but in the horse, sheep, dog, and others, it occupies a very considerable space at the base of the brain, and is connected with the inferior portion of the hippocampus. It terminates in a bulb composed principally of cineritious matter placed over the cribriform plate of the ethmoid bone; and through perforations of this, numerous branches pass to the nose, where they become more or less combined with branches of the fifth; the branches of one portion, after an expansion on the membrane covering the plates of the ethmoid bone, converge and become connected with a branch of the lateral nasal nerve, and then separate to be distributed on the membrane covering the turbinated bones and the rest of the exterior walls of the nose; the other portion is continued upon the membrane expanded on the septum; the branches of the nerves, soon after their entrance into the nose, become impacted in the membrane, copiously supplied by arteries, and having underneath numerous large veins so as to give it a cavernous appearance by which it can be made more or less tense by modifying the act of respiration. This mode of distribution is well seen in the horse.

The optic nerve in mammalia is very similar to that in man. The tract is a

continuation from the thalamus, after this has received the true visual tract; it is connected with the surface of the nates, the geniculate body, the sensitive tract, the mammillary eminence and the part surrounding this; the commissure is not generally so large as in man, therefore each nerve passes more directly to its foramen, and is longer or shorter in different animals according to the nearer or more distant position of the eye with respect to the brain; it becomes expanded into a soft retina, similar to that in man.

In mammalia, the third nerve arises from the inner side of the crus of the brain, as in man; it passes into the orbit and supplies all the muscles except the superior oblique, the abducent and retractor. It sends a branch to be joined by one from the fifth in the ciliary ganglion; from which, in the monkey, branches similar to those in man proceed to the interior of the eye; in the porpoise the ganglion is joined by a branch from the third and fifth; but in many other animals the ganglion is by no means proportionate to the size of this organ, and sends off only a few thick branches; more branches of the fifth, however, appear to terminate on the eye-lids and the conjunctive membrane. In the jaguar, there is a ganglion on the portion of the third, which eventually terminates in the inferior oblique muscle; it sends a branch to pass on the outer side of the optic nerve into the eye; it sends also a very large branch to be joined by a branch from the superior nasal, but not to form a ganglion, and from this junction branches pass along the inner side of the optic nerve into the eye; the ciliary ganglion and nerves are larger in proportion to those of the ass and sheep, but the branches entering the eye are not so numerous as in man. In the pig, the third nerve supplies the usual muscles of the eye, and gives off some ciliary filaments. A branch of the third is then joined by a nerve formed of two branches; one proceeding from the first trunk of the fifth, the other from the beginning of the second trunk, at a spot at which a branch of the sympathetic is received. After this union, it gives off ciliary filaments to pass along the optic nerve; it is then directed to terminate in the inferior oblique muscle. The ciliary nerves are very insignificant, but numerous branches of the fifth supply the eyelids. In the calf, the branch of the fifth, joining the branch of the third in the ciliary ganglion, arises from the Gasserian

ganglion near the first trunk of the fifth, at the part receiving the branches from the superior cervical ganglion of the sympathetic; it appears to be a continuation of one of those branches of the sympathetic which also communicated with the sixth; it passes into the orbit, and receives a branch from the third nerve to form the ciliary ganglion. In the sheep and goat, the branch given to the lenticular ganglion arises from the Gasserian; in the goat it is a very slender thread, but divides into two, one of which joins the lenticular ganglion, the other, one of the ciliary nerves arising from this. In the dog, the branch joining that of the third nerve in the lenticular ganglion proceeds from the superior nasal.

The fourth nerve, as in man, arises behind the quadrigeminal bodies from the oblique tract, descending near the roof of the passage from the third to the fourth ventricle. It terminates on the superior oblique muscle of the eye.

The larger portion of the fifth emerges from the crus of the cerebellum and the annular tubercle; one portion of it arises from the involuntary centre, the other from the sensitive centre forming the ventricular cord on the floor of the fourth ventricle; the smaller portion is on the inner side, and arises from the tract of the larger portion of the intermediate layer of the external region. With the exception of those of the smaller portion, its fibrils undergo a change of arrangement in the Gasserian ganglion, and become formed into three trunks, the smaller portion passing with the third. In many animals, as the horse, ass, calf, and goat, the fibrils forming its trunks, and particularly the second, are very coarse; but not in others, as the dog, baboon, and monkey. It appears to communicate with the sympathetic, particularly at the Gasserian ganglion. In the porpoise the fifth has a larger and smaller portion. The smaller is placed on the posterior and median margin of the larger as they emerge from the annular tubercle: the larger forms a Gasserian ganglion, but the smaller portion continues separate.

The first trunk differs very little from that in man. In the calf the branch of the superior nasal passes through a foramen to the superior part of the cribriform plate, but continues to be covered by the dura mater lining this, to which it gives filaments; two principal branches enter the nose, one passes on the Schneiderian membrane of

the septum, and may be traced near to the extremity of the nose, the other passes on the Schneiderian membrane, at the superior part of the outer surface of the nose, and at about one-third of the distance from the upper part of the nose sends a branch outwardly, underneath the nasal bone, to the strong membrane covering the Schneiderian membrane, it then passes to the extremity of the nose, and terminates on the Schneiderian membrane, and the strong membrane covering this. The continuation of the superior nasal forwards, after it has sent the large branch into the nose, appears to occupy the place both of the superior nasal and supra-orbital, by its supplying so considerable a part of the upper eye-lid and eye-brow with branches. In the dog it gives off the superior nasal, this sends one branch into the nose, and then passes to the inner angle of the eye, to terminate on the upper eye-lid and eye-brow; it gives off another that may be compared with the supra-orbital in man, which sends a branch to join one from the temporal, for the lachrymal gland, and then supplies the middle of the upper eye-lid and eye-brow. There are variations in different species, so that the nasal may send off a considerable branch to the middle of the eye-lid and eye-brow, just before it leaves the orbit, or this branch may be sent off at the beginning of the first trunk, and then resemble more the supra-orbital in man. In the pig it gives off the superior nasal, which sends one branch into the nose, and then passes to the inner angle of the eye, to terminate on the eye-lid and eye-brow: it gives off another, that may be compared with the supra-orbital in man, which communicates with the lachrymal nerve, and then supplies the middle of the upper eye-lid and eye-brow; it gives off the lachrymal, which sends filaments, with others from the temporal to the lachrymal gland, and then supplies the outer part of the upper eye-lid. In the sheep, minute filaments from the supra-orbital nerve enter the sclerotic coat of the eye; a small branch gives filaments to the levator muscle of the eye, and then joins the fourth nerve, before its termination in the superior oblique muscle; filaments also pass to the other muscles of the eye, the fat and conjunctive membrane of the eye-lids. In the porpoise the first trunk is very small, and after giving filaments to the lenticular ganglion terminates on the skin of the upper eye-lid.

The second trunk of the fifth is usually very thick; it gives off the malar nerve,

which divides into a temporal and malar branch, as in the dog, but varies in size in different animals, according to the extent of the parts to be supplied; in the dog the temporal branch of the malar gives a branch to communicate with one from the supra-orbital for the lachrymal gland, and then passes out at the exterior of the orbit, communicates with a branch of the hard portion, and is distributed to the cutaneous muscle and skin of the temple. The malar branch, on emerging from its foramen, communicates with a branch of the hard portion, and then terminates on the skin of the face and the lower eye-lid. In the calf, pig, and sheep, the temporal and malar branches arise separately. In the calf a nerve is sent from the Gasserian ganglion, close to and communicating with the temporal; it supplies the lachrymal gland, and then terminates on the outer part of the upper eye-lid and eye-brow; the temporal emerges at the exterior of the orbit, communicates with the hard portion, and gives branches to the superficial muscles and skin of the temple; the greatest part of it then passes outwards, to be distributed on the horn. The malar portion, on emerging, communicates with the hard portion, and is distributed principally on the lower eye-lid. Two other branches from the Gasserian ganglion pass outwardly in a canal on the inner plate of the frontal sinus, as far as the junction of this with the outer plate, near the insertion of the horn. In the pig, the temporal sends off filaments, which communicate with others from the outer branch of the lachrymal, and then passes on the temple, and joins a large branch of the temporal branch of the hard portion, to supply the outer part of the orbicular muscle and the skin of the temple; the malar emerges from the orbit, and communicates with a filament of the hard portion, and then supplies the lower eye-lid. In the monkey, the second trunk of the fifth gives off the Vidian, the lateral nasal and palatine, as in man, but not from a ganglion. In many other animals the second trunk gives off the lateral nasal and palatine, which sometimes arise in one branch, and then separate; the lateral nasal becomes connected with the Vidian, and on entering the nose becomes also connected with part of the olfactory, and is distributed on the Schneiderian membrane; the palatine passes through one or several foramina, to be distributed on the palate. In the calf, the lateral nasal and palatine nerves arise separately, but communicate afterwards by

several branches at the posterior part of the nose and palate, before they pass to their respective destinations. The lateral nasal nerve, on entering the nose, divides into two portions; one sends filaments to the concentrated part of the olfactory nerve, as in the horse, and divides into branches, to be distributed on the Schneiderian membrane, covering the turbinated bones, and the rest of the exterior surface of the nose; the branches pass between this membrane and the periosteum; the other passes to the Schneiderian membrane covering the septum, on which it is chiefly distributed; a branch passes forward, and, at about one-third of the distance from the extremity of the nose, escapes through the palate bone, and is continued on the middle of the palate, to terminate at the anterior extremity of this part. Three bundles of small branches of the palatine nerves pass to the posterior portion of the palate, the large part of the nerve then passes through the large foramen, and divides into several branches, which proceed to the middle and anterior portions of the palate, and distribute filaments in their course. In the jaguar, a fine branch and a large one, from the second trunk, supply the teeth of the upper jaw, filaments of both pass through perforations of the bone to the double teeth, the rest of the large branch then supplies the large pointed tooth, passes round the fang of this, and descends to the fang of the first incisor, and winds round this to supply the other two. In the calf, six or seven branches pass very obliquely forwards, so that they ramify on the capsules of the pulps, and enter the teeth at a distance from their origin; some of them communicate before their termination. After supplying the teeth, the continuation of the trunk, in various animals, emerges beneath the orbit, at one, two, or three foramina, at different distances from the orbit, carefully defended against injury by the prominence of the inferior margin of the orbit, or when it emerges lower down by a ridge of bone; and although its exit by several foramina is constant in the baboon, it is in some also accidental, and in the calf not unfrequently occupies a single opening on one side, and two on the other; its usual distribution is, however, nearly the same; it gives branches to the levator muscle of the upper lip in the calf, but in the pig the branches pass through the fibres of the long muscle of the snout to the skin; it then divides into numerous branches, which communicate generally with

branches from the hard portion of the seventh, and terminate on the muscles and skin of the upper lip and the exterior of the nose, whilst a few pass to the interior of this organ. In the pig, some filaments of the hard portion communicate with several branches of this trunk, just before they terminate on the upper lip and snout. In the porpoise the second trunk is large; it sends off a branch corresponding with the malar, to pass on the outer side of the orbit to the skin of the lower eye-lid; it sends a branch in a groove to the palate, and a large branch somewhat analogous to the supra-orbital and superior nasal, to give a branch to a levator muscle of the parietes of the blowing hole, which is also supplied by the hard portion; the rest of the trunk corresponds with the infra-orbital, it passes forwards and sends branches to the skin of the snout and upper lip.

The branches of the third trunk of the fifth differ very little from these in man, except that they are larger or smaller according to the varying size of the parts furnished by them. The nerve given to the circumflex muscle of the palate is generally very slender. The deep temporal, supplying the temporal and masseter muscles, is large in proportion to the branches sent to the pterygoid muscles in the jaguar. There is some difficulty in making comparisons relating to the size of the nerves of different animals, as they are composed of finer and closer fibrils in carnivorous animals than in herbivorous, and have not an equal bulk in proportion to the same extent of parts receiving them.

The superficial temporal nerve in the calf passes behind the ramus of the jaw; it sends a large branch forward to join the middle branch of the hard portion of the seventh; it sends a large auricular branch backwards, one part of which passes to the inner surface of the concha of the ear; the other communicates with a branch of the hard portion passing to the muscles of the external ear, and then terminates on the skin near the margin of the concha. The branch of this nerve passing to the face is large in the horse and less in the calf; it becomes united with a large branch of the hard portion in the face of both these animals, but with a mere filament in the sheep; the auricular branch varies very much with the size of the external ear. In the calf, the trunk, before dividing into the gustatory and inferior dental nerves, gives a

branch to the internal pterygoid muscle; others are given to this muscle by the otic ganglion. The gustatory nerve exists only in mammalia; it receives the cord of the tympanum, it passes between the external and internal pterygoid muscles, next underneath the membrane lining the mouth, and then between the lingual muscle and the insertion of the genio-hyoideal, and divides into branches; some of which communicate with others of the ninth, and pass upwards to terminate in the papillæ at the anterior and middle portions of the surface of the tongue; it gives branches also to the salivary glands, and a considerable one to be distributed on the portion of the membrane of the mouth connecting the side of the tongue with the lower jaw. In some animals, as in man, it is difficult to determine whether the branches do not give filaments to the muscles in passing to the surface of the tongue. The gustatory nerve is rather larger in proportion to the size of the tongue in man than in the baboon, and in this than in the sheep, goat, calf, and ass; and in these than in the dog, and in this than in the jaguar. The coarseness of the texture of the fibrils is, however, generally in the reverse order, except in man and the baboon, it being the greatest in the sheep, goat, calf, and ass, and least in the dog and jaguar. The cord of the tympanum is almost peculiar to mammalia; a resemblance of it has been traced in birds. In the calf, it begins at the hard portion, and passes across the membrane of the tympanum, nearly as in man; it communicates with the tympanine nerve of the glosso-pharyngeal, and the sympathetic on the outside of the petrous portion forming one surface of the tympanum; it passes downwards, and at length becomes intimately united with about an inch of the gustatory nerve; a nerve is again given off from the side at which the cord of the tympanum joined the gustatory; this communicates with two other branches, and is then distributed on the posterior part of the surface of the tongue; by dividing communicating filaments this might be made into a continuation of the cord of the tympanum; but it would be a deception. In the ass, it is in apposition with the gustatory nerve for a short distance, and then becomes intermixed with fibrils of this nerve. In the dog, it becomes intimately conjoined with the gustatory. In the goat, it forms a distinct oval ganglion close to the tympanum, which sends filaments into this, and then descends and joins the gustatory nerve, with the fibres

of which it coalesces. In the porpoise, the third trunk gives off a large branch, the mylo-hyoideal, to the muscles corresponding with the mylo-hyoideal and the inferior belly of the digastric; it also gives off the gustatory, which sends one branch to communicate with a branch of the ninth, and then passes in small filaments to the surface of the tongue; two other large branches of the gustatory supply the membrane between the jaw and side of the tongue; it sends the inferior dental into the lower jaw to supply the teeth, which then emerges at the mental foramen to supply the lower lip; it gives off the buccal to the parts about the angle of the mouth; it gives branches to the temporal, pterygoid, and masseter muscles. A small superficial temporal passes to the skin near the auditory meatus, and communicates by a filament with the hard portion. The branch of the gustatory sent to the tongue is not so large as usual in mammalia, but the other portion given to the membrane at the side of the tongue is larger.

The inferior dental nerve, just before entering the lower jaw, gives off the mylo-hyoideal nerve which descends, closely connected with the periosteum lining the inner surface of the jaw, until it reaches the inferior belly of the digastric muscle. It is larger in carnivorous than in herbivorous animals; it supplies the inferior belly of the digastric and the mylo-hyoideal muscle only in man and some animals, as the baboon, pig, and sheep, whilst in the dog and fox, it sends branches to the face to join some from the hard portion of the seventh, and others forward to the cutaneous muscle underneath the jaw; on the right side of the face of a dog, two branches joined the hard portion, and on the left only one; whilst a branch was given by the hard portion to the inferior belly of the digastric muscle; in the pig, it sends a branch outwards to the salivary glands. The inferior dental nerve passes behind part of the internal pterygoid, and then part of the insertion of the external; it enters the lower jaw, and gives branches to the teeth; it usually emerges at a single foramen near the chin, when it immediately divides into two or three branches; some of which communicate with filaments of the hard portion, and all of them, after ramifying, terminate on the muscles and skin of the lower lip. In the baboon, it sends branches through several foramina. In the pig, from near the angle of the mouth, it begins to send out four

small branches from separate foramina; the second entirely and immediately joins the large branch of the hard portion proceeding towards the chin, and the rest communicate with some of the branches of this nerve. The principal part of the inferior dental nerve then emerges from the foramen near the chin, and ramifies in the usual manner. The buccal nerve in the calf gives a branch to the external pterygoid muscle; it then passes over the inner surface of this muscle; it emerges from underneath the anterior edge of the masseter, and divides into branches, which terminate on the buccinator muscle and the skin of the face, and form considerable communications with branches of the hard portion. The buccal in a great measure supplies the cheek, or that triangular portion situated between the masseter muscle and the corner of the mouth, so that it is larger or smaller in different animals according to the extent of this part.

The sixth in the monkey arises from the posterior edge of the annular tubercle and the pyramidal body, nearly as in man; and in the horse and sheep, from the trapezoid body in the groove corresponding with that continued downwards on the outer side of the pyramidal body. It communicates with the sympathetic in the monkey, dog, jaguar, pig, calf, and others; and in the calf also with the first trunk of the fifth. It terminates in the abducent muscle; also in the retractor in the porpoise and other animals.

The character, origin, and distribution of the auditory nerve are nearly the same as in man. It arises from the side of the fourth ventricle and the external portion of the restiform body, and has a slight connection with the involuntary centre. It communicates with the hard portion in the internal auditory meatus; after its division one portion passes to the base of the cochlea, and sends branches through perforations in the modiolus to the spiral lamina, on which it forms a more fibrous or thready retina than the optic nerve, whilst the rest terminates in the vestibule and the semicircular canals. In the porpoise it is very large on account of the size of the cochlea.

The hard portion of the seventh in the horse and ox arises from the tract of the larger portion of the intermediate layer of the external region as it passes through the annular tubercle, more externally it is connected with the trapezoid body, and in the porpoise proceeds from the prominence occupied by the trapezoid body and

from the annular tubercle. It communicates with the vestibular division of the soft portion in the internal auditory meatus in the calf; after it has left this, it receives the cord of the tympanum, and sends a branch to join the trunk of the par vagum, but it does not receive a branch of the Vidian nerve as in man and the monkey; this deficiency may, however, be supplied by the filaments of the sympathetic, which pass on the outer surface of the labyrinth. The branch sent to the par vagum in the goat, forms a ganglion at the point of union with this nerve. After it has escaped from its foramen, it is large and of a different size in various animals; in the baboon and monkey its distribution is very similar to that in man, but the branches are smaller; it gives a branch to the superior belly of the digastric muscle, and to a slender one like the stylo-hyoideal in the baboon and dog. In the dog it sends a branch to pierce the cartilaginous portion of the tube of the external auditory meatus, and terminates on the skin. It gives branches to communicate with others of the first cervical nerve, to terminate on the cutaneous muscle of the neck and skin of the auricle. It gives off a branch which becomes connected with the superficial temporal branch of the third trunk of the fifth, to be distributed on the muscles of the external ear. It then divides into three principal branches, the temporal passes over the eye-brow to the cutaneous muscle of the forehead and nose, gives filaments to the orbicular muscle of the eye-lids, and communicates with the temporal and malar branches of the malar and supra-orbital nerves. The middle branch passes towards the upper jaw, and communicates with branches of the buccal nerve and the second trunk of the fifth, and terminates on the muscles of the middle portion of the face and the upper lip; the inferior branch extends towards the lower jaw, communicates with the buccal and the mylo-hyoideal branch of the inferior dental, and then communicates with branches of the inferior maxillary nerve on the chin, and gives branches to the muscles of the face and lower lip. In the pig, after giving branches to the salivary glands and surrounding parts, it divides into three principal branches: the temporal is the smallest; one part of it passes over the eye-brow, the other communicates with the auricular branch of the third trunk of the fifth, and supplies the more anterior muscles of the external ear; it sends also a large branch backwards to the more posterior muscles of this part.

The inferior branch passes quite behind the angle of the lower jaw, and mounts up into the face, along with the facial artery, just beyond the anterior insertion of the masseter muscle; it sends a branch forward along the lower jaw to communicate with branches of the inferior dental nerve, to be distributed on the face and lower lip; it then joins the middle branch, where there is an intimate connection between this junction and part of the buccal, passing towards the angle of the mouth; it gives branches to the muscles of the lips and mouth, and supplies the large muscles of the snout, as well as the smaller ones connected with the skin of this part. In different animals, the several branches are larger or smaller, according to the extent of the parts supplied; the ramifications of these also vary with the form and direction of the muscles. The temporal branch in the baboon and monkey is small, also in the sheep, but in the calf it is large, and still larger in the dog. There are differences also with respect to its degree of communication with the branches of the fifth; in the sheep, both pass nearly separate to their destination: the final distribution of the branches arising from both is not, however, in consequence much altered. The hard portion in the porpoise on emerging from the cranium sends off slender branches at the lower part of the face; two pass down the neck to the cutaneous muscle, the other to muscular fibres on the face; it is then continued across the face and underneath the orbit, and sends filaments to the muscle of the eye-lids, and to those at the angle of the mouth; it then mounts upwards somewhat like the inferior branch in the pig, and terminates on the muscles connected with the blowing-hole.

The glosso-pharyngeal nerve arises from the involuntary centre near the restiform body; it passes out of the head with the trunk of the par vagum. It then forms a distinct ganglion in the dog; in the goat and calf, it has a slight change in texture; but in the ass, sheep, and jaguar, it has not any discernible difference; it, however, varies in this respect in different instances of the same animal. It soon gives off the tympanine nerve, which is usually large when compared with that in man; it may be seen ramifying in considerable branches on the external surface of the labyrinth, particularly in the horse, calf, and sheep, and communicating there with branches of the sympathetic, and the cord of the tympanum. It communicates with the superior

cervical ganglion of the sympathetic. In the ass, it adheres to and gives filaments to the membraneous pouch connected with the posterior part of the fauces. It supplies the stylo-pharyngeal muscle and the pharynx, and becomes connected with the pharyngeal plexus, which is much less intricate in animals than in man. It then passes forwards, distributing branches to the tonsils and membrane between the epiglottis and tongue, and terminates on the posterior part of the surface of the tongue. The variation in the proportion of the glosso-pharyngeal nerve to the tongue is not generally very remarkable in different animals, but in the jaguar only one small branch was traced to the membrane on the outer edge of the posterior part of the tongue. In the porpoise it arises near the upper part of the restiform body: it is near the size of that in man; on emerging from the cranium, it sends a large branch downwards to the bifurcation of the carotid artery into the internal and external, where it forms a ganglion which is joined by a branch from the par vagum; it resembles that portion of the pharyngeal plexus sent to the external carotid artery in man, and is probably for a similar purpose. The nerve itself then passes forwards and gives a branch to a broad muscle connected with the styloid process and pharynx, and may be the stylo-pharyngeal; it then gives filaments to the muscles of the pharynx, and terminates in the membrane of this passage connected with the base of the tongue.

The par vagum arises from the involuntary centre near the restiform body. In the calf, goat, and ass, it soon sends off a branch to join the hard portion. In the jaguar, dog, pig, and rabbit, there is a ganglion near the place at which the superior laryngeal nerve arises. In many others, as the monkey, calf, ass, and Cashmere goat, there is an intricate disposition of some of the fibrils of the nerve about the origin of the superior laryngeal, but not a distinct fleshy ganglion. A nerve is not in all animals fit for its destination just after leaving the brain, but in many instances requires to have some change effected in the disposition of its fibrils, and particularly at the departure of its branches, and this change may be effected by a fleshy ganglion in some instances, and a thready interchange of fibrils in others, either of which disposition becomes a modified but similar means for suiting the peculiarities of each animal. In the pig, the superior laryngeal nerve gives a branch to the pharynx and the crico-thyroideal muscle,

and terminates on the membrane of the glottis, the epiglottis, and the superior part of the larynx, and communicates with branches of the recurrent, after which this nerve terminates on the muscles of the glottis. In the jaguar, the enlargement is situated much lower down than in the pig and other animals; the larynx is also placed lower in the same degree; the laryngeal nerve arising from it gives branches to the pharynx and crico-thyroideal muscle, before it passes to the glottis. The course of the par vagum through the neck is very similar to that in man; but in many instances, as the calf, sheep, dog, and jaguar, the prolongation of the sympathetic from the first cervical ganglion adheres to it, and in the calf forms communications with it; but in the rabbit, hedge-hog, and others, the sympathetic is generally separate from it: it is so in some species of the baboon and monkey, if a partial adhesion a little below the superior cervical ganglion be excepted. In the jaguar, after the sympathetic has left the right trunk at the bottom of the neck, it communicates with the inferior cervical and first thoracic ganglia, and gives off some branches to the heart, and sends the recurrent round the subclavian artery, which, as well as that on the left side, communicates very much with the cardiac nerves before it passes up to the larynx; the trunk then gives filaments to the trachea, and passes to the back of the lungs, where it gives off the pulmonary plexus, which communicates with the thoracic plexus as in man; it then sends off a branch to be joined by one from the left trunk to form the anterior cord which gives filaments to the lungs, and one to the right auricle, and the termination of the inferior vena cava; it sends off a large branch to join the posterior cord; the anterior cord then passes through the diaphragm, and terminates on the anterior surface of the stomach; some of its branches communicating with branches of the sympathetic accompanying ramifications of the cœliac artery. The left trunk, after it has given off the sympathetic, sends the recurrent round the arch of the aorta to communicate very much with the cardiac nerves before it passes up to the larynx; the trunk gives off several cardiac branches, and a large branch to join the anterior cord; the rest of it is then joined by a large branch of the right trunk to form the posterior cord, and pass through the diaphragm to give branches to the cœliac plexus and to the broad extremity of the stomach, and then terminate by distributing branches on the

posterior surface of the stomach. Although there be some variation in the size and number of the branches given off by the par vagum, they are very similar to those in the jaguar. After sending branches to the thoracic viscera, the two trunks do not separate into so many large branches as in man, but combine into two principal cords of unequal size; and although they do not form so intricate a plexus as in man, they give off numerous filaments, which cover the outer surface of the œsophagus, and are extended in some measure to the cellular membrane and the aorta; the smaller or anterior cord, after passing through the diaphragm, sends branches to the lesser omentum in the baboon, calf, and other animals, to form the left hepatic plexus; but in the dog, these pass almost immediately between two lobes of the liver on the left side for the same destination; the other branches of the anterior cord follow the anterior surface of the smaller curvature of the stomach, as in man, and communicate with branches of the right hepatic plexus. The larger or posterior cord, whether it forms one or two portions on the œsophagus, before it pierces the diaphragm, gives branches to the large extremity and posterior surface of the stomach; but a considerable part of it intermixes with the cœliac plexus, from which some of its branches may be traced to the beginning of the large intestines. In ruminating animals, both cords give branches to the supernumerary stomachs; but with the exception of their larger size, they are the same as in man and other animals. In one baboon, two branches of the right trunk were joined into one behind the œsophagus, and then combined with the portion of the left trunk to form the larger or posterior cord; but in another baboon, one of these branches from the right trunk joined the posterior cord to pass to the cœliac plexus and the stomach, the other descended separately also to pass to the cœliac plexus and stomach. In the ass, the anterior cord of the par vagum is very small; it gives some filaments to the stomach and others to pass on the small omentum to the liver, where they communicate with branches of the right hepatic plexus. A great portion of the posterior cord forms a thready expansion, part of which passes in branches to the stomach, and the rest to the cœliac plexus.

In the porpoise the par vagum communicates with the sympathetic, but is otherwise separate from this, as in the baboon, rabbit, and others; it gives off a small

recurrent which winds round the subclavian artery on the right side, and the arch of the aorta on the left; it sends filaments to the œsophagus; it gives several branches to the heart, and copiously supplies the lungs; it then passes to the œsophagus, where its branches are more deeply imbedded in the muscular fibres than in other animals; the greater portion corresponding with the posterior trunk supplies the first, or cuticular, and the second, or villous, stomach; after forming a sort of corona or ring on the lower part of the œsophagus, it sends filaments to the diaphragm and to the left semilunar ganglion; it also sends branches towards the other three stomachs or duodenal pouches, a branch to the liver, and others to communicate with branches from the cœliac plexus on the branches of the coronary artery passing to the stomachs, and with some of the branches of the hepatic plexus as this passes to the liver; the smaller portion corresponding with the anterior trunk passes down and sends some filaments to the lower portion of the œsophagus and the first stomach, but its principal part divides to join both semilunar ganglia.

The cervical portion of the par vagum is rounder in the jaguar than in the ass, in which it is rather broader and flatter, so that there is not much difference in their size; it is nearly equal in the jaguar and baboon; in these it is a little less than in the dog, and less in the dog than in the pig. The anterior cord on the œsophagus, just before it passes through the diaphragm, is nearly of the same size in a young ass, about a month old, and one a year older; but the posterior is somewhat larger in the older. The anterior cord is rather less in the ass than in the baboon and jaguar, in both of which it is equal; it is less in the jaguar than in the dog, and less in the dog than in the pig. The posterior cord is less in the baboon than in the ass and jaguar, less in these than in the dog, and less in the dog than in the pig. The cervical portion was larger in the calf a week old, than in the ass a month old; the anterior and posterior cords, after supplying the lungs, were both also much larger in the calf, but this was before the ruminating stomachs had been much used.

In mammalia, the pharyngeal plexus is very much like that in man, but not near so complicated. In the ass, a branch is given from the glosso-pharyngeal, and from the union of the par vagum and accessory, and from the superior cervical ganglion of

the sympathetic; these communicate and terminate on the pharynx. In the ass, some filaments, from the prolongation of the sympathetic, after its connection with the trunk of the par vagum, are also given to the pharynx. In the dog, a communication takes place between the ninth, the accessory, the par vagum, and the glosso-pharyngeal, and from this and the superior cervical ganglion of the sympathetic, and the descending portion of the ninth, branches are given to form the pharyngeal plexus; the superior laryngeal nerve is given off by itself, a little below this, from the ganglion of the par vagum, and sends a branch to the crico-thyroideal muscle. In the jaguar, the pharyngeal plexus is formed from the glosso-pharyngeal, the conjoined par vagum and accessory, and filaments from the superior cervical ganglion of the sympathetic; the lower part of the pharynx also receives branches from the superior laryngeal nerve. In the pig, the pharyngeal plexus is formed of a branch of the glosso-pharyngeal nerve, a broad expansion from the conjoined par vagum and accessory, and a branch from the superior cervical ganglion of the sympathetic. Some variation exists in the formation of this plexus, on account of the difference of the par vagum and the connection between this and the sympathetic; it terminates principally in branches on the pharynx; it sends some on the branches of the carotid artery to supply their coats; also to the salivary glands, but these sometimes rather appear as if they proceeded from the superior cervical ganglion of the sympathetic, and only communicated with this plexus.

The ninth arises from the larger portion of the intermediate layer, at the side of the pyramidal body; it passes out, in two or three bundles, which unite, and then communicate more or less with the trunk of the par vagum and the sympathetic; in the ass, there is not a communication with the par vagum as in man, but there is with the superior cervical ganglion of the sympathetic; in the calf, there is not a communication with the par vagum. In the jaguar, the ninth is large in proportion to the size of the gustatory nerve, as well as of the tongue; probably the difference arises from the great length of the muscles passing from the hyoid bone and lower jaw to the tongue; in the pig, as well as in the jaguar, it becomes strongly united with the par vagum and accessory; but it appears to be principally, if not altogether, by dense cellular membrane. The descending branch, except in the baboon and monkey, is usually more slender than

in man; in the jaguar, there are three slender branches, one for the sterno-hyoideal muscle, another for the thyro-hyoideal, and the third, which is joined by the anterior trunk of the sub-occipital, to terminate on the sterno-hyoideal and sterno-thyroideal muscles; the sub-occipital, in passing down, forms a broad membranous attachment to the ganglion of the par vagum. In the monkey, the descending branch combines with the anterior trunk of the sub-occipital and the first and second cervical nerves, for the muscles connected with the hyoid bone and thyroid cartilage; the same disposition occurs in the baboon, except that the branch of the sub-occipital rather joins the first cervical nerve, which at this spot gives off its branch to pass with the descending branch of the ninth, and the one from the second cervical nerve. In the fox, the descending branch is very small, being a mere filament; it is joined by the anterior trunk of the sub-occipital. The ninth afterwards supplies the stylo-glossal and genio-hyoideal muscles, and then, as in the pig particularly, spreads out into a fan-like plexus or retina, and passing between the two planes of the genio-hyo-glossal muscle, supplies this and the lingual, and the delicately pectinated muscular structure forming the surface of the tongue. In the porpoise the ninth arises from the outer side of the pyramidal body; it gives a branch to communicate with the sub-occipital and first cervical nerves, to terminate on the large muscle of the throat that may be compared with the sterno-hyoid; it then passes forwards and divides for the genio-hyoideal, the stylo-glossal, the hyo-glossal, the genio-hyo-glossal, and lingual muscles, and communicates with the gustatory.

The accessory nerve arises, as in man, principally from the spinal cord, but has some fibrils from the involuntary centre near the origin of the par vagum; it arises also from the spinal cord and from the posterior bundles of several cervical nerves. It passes out near the par vagum; and in the goat, ass, pig, and jaguar, becomes united with this nerve; and from both, filaments pass to form a cord to join the pharyngeal plexus. In the fox, it joins the glosso-pharyngeal, the trunk of the par vagum, the ninth and sympathetic; it enters the sterno-mastoid muscle, to which it gives branches; it then communicates with the union of the anterior trunks of the first and second cervical nerves, and with a branch of the third and one of the fourth, and terminates in

the trapezius muscle. In the ass, it gives a large branch to the sterno-mastoid muscle, it communicates with the first and second cervical nerves and terminates in the trapezius muscle. In the porpoise it is small, it begins from the spinal cord near the posterior root of the first cervical nerve, it acquires more fibrils as it ascends, it passes out to the sterno-mastoid and trapezius muscles.

SPINAL CORD.—The membranes of the spinal cord are the same as those of the brain, with the addition of the denticulated ligament; they correspond with the same in man. The external and internal appearance of the cord is very similar to that in man, but is larger or smaller in different regions, according to the motions of the spine, and the quantity and size of the nerves to be produced. Its structure is in many respects like that of the brain, being composed of grey and white matter. In its natural state, when divided longitudinally, it appears almost without any definite character; but an horizontal section shows the grey within the white, forming four cornuated processes. To the naked eye the white and grey appear defined, but in a dry thin preparation the grey is seen to radiate amongst the white. When hardened in spirits its surface may be separated into irregular longitudinal fibres, which, when dried, appear to be composed of meshes similar to those of the brain. The internal position of the grey favours the safety of the delicate roots of nerves originating from it, and allows an uninterrupted supply of blood; and the white, aided by the pia mater, furnishes them with a greater firmness and security externally. The nervous roots, in radiating from the grey matter towards the circumference, appear as fine wavy threads communicating with each other, and with the meshes of white, forming longitudinal tracts. There is a more or less thick layer of roots continued from one end of the cord to the other. Each root is defined by an accompanying artery; the roots emerged from the white matter appear beneath the pia mater in coarser wavy lines just before their collection into fasciculi for forming externally the fibrils previously to their combination into separate nerves.

If a portion of the injected cord be dried and magnified, and the multiplicity of minute vessels noted, it is difficult to determine how they are with such regularity replenished with blood throughout the entire cord during the frequent and varied

motions of the spine. The arterial circles placed at the more posterior parts of the bodies of the vertebræ, and described by Willis, offer some explanation. The arterial circles receive blood, like the spinal arteries, from the vertebral, intercostal, lumbar, and sacral arteries. The branches leading to the spinal arteries are conducted along the bundles of nerves, and, by the communications of similar branches with the arterial circles, allow a uniform supply of blood continually throughout the cord, whilst the plexuses of veins are fitted for accommodating any returning blood and preventing its delay in the cord.

The nerves arising from the spinal cord consist of an anterior and posterior row of bundles on each side. The fibrils of the posterior bundles are by far the coarsest, and have ganglia attached to them on leaving the spinal sheath. The ganglia are not always placed as in man; but in the baboon, the dorsal, lumbar, and sacral are contained within the spinal canal; and in some animals, as the ass, calf, and goat, are not so compact as in man, the baboon, jaguar, dog, fox, pig, and others, but of a coarser texture, and have less of the red matter intervening between the nervous fibrils; at the anterior point each ganglion is joined by the anterior bundle to form a nerve, in which the fibrils of both become intermixed. In the ass, the different bundles of fibrils composing a nerve, having passed through separate openings in the sheath of the dura mater, form little ganglia, which communicate together just at the beginning of the nerve; it is nearly the same in the calf and goat. The principal difference of their structure in numerous animals consists of a greater or less separation of the fibrils into more or fewer ganglia, and a varying quantity of red matter. The posterior fasciculi in the porpoise are rather smaller than the anterior, probably on account of the small extent of skin and great development and power of the muscles; they form close and fleshy ganglia externally to the sheath of dura mater; those of the caudal are not so distinct as the cervical and dorsal. The spinal cord is embraced closely by the sheath of dura mater; but, as there is not more than a very slight motion between the vertebræ, much room for bending is not required. The vascular net-work occupies a large portion of the canal.

In the jaguar the nine, and in the sow the seven, first bundles of dorsal nerves

point downwards, the remaining dorsal and two first lumbar upwards, in passing to the ganglia at the notches leading from the spinal canal, and thus are directed each way towards the most yielding portion of the spinal cord; they are thereby prevented from being stretched when the animal bends the back much, and particularly in springing forwards. The third lumbar ganglion begins to incline downwards, and the rest, as well as the sacral, then take an almost perpendicular direction.

The enlargements of the spinal cord are more or less extensive, according to the number and size of the nerves furnished by it in a given space, and the motion to which the different parts must be subjected, the thickest portions being placed where there is the least motion. It need not correspond with the extent of the spinal canal, but for more or less of its length have nerves substituted for it. In the hedgehog it is short and thick, and terminates very high up; its point reaches to about the sixth dorsal vertebra. In man its extreme point reaches to the second lumbar vertebra; but the thick portion, forming the principal part of the centre of the cauda equina, is placed much higher. In simiæ it descends a little lower, the thick portion extending to the bottom of the second lumbar vertebra, and its point reaching to the inferior part of the fourth; in a very small monkey its point reached to the bottom of the fifth; its thick portion extends to about the bottom of the sixth lumbar vertebra in the calf, goat, dog, jaguar, pig, and other animals, and its point into the canal of the sacrum. In the porpoise it terminates in a point about the sixth lumbar vertebra; the nerves of the cauda equina are then continued in the spinal canal for a considerable distance, and afterwards the canal is occupied by a posterior caudal artery; below the cervical portion the spinal cord diminishes, and about the last rib enlarges again for giving origin to the numerous and large caudal nerves, and it is not much less at this part than in animals having lower extremities. When, therefore, it is shorter, the nerves of the cauda equina occupy a greater length of the spinal canal; so that they are longest in the hedgehog, next in man and some animals, whilst in others they are very short, with the exception of several slender ones continued through the canal to some distance into the tail.

The spinal cord is continued from the oblong medulla in a canal formed by the

extension of the arches from the back of the body of each vertebra, to its spinous process; and as these have different motive capabilities in each region of the spinal column, the utmost nicety is required in adapting its delicate texture to them at the proper places. The spine has not only to sustain the head and be adapted to the motions of the trunk, but to the position and free action of the limbs and the support of the viscera. In man the degree of flexion of all the cervical vertebræ together is very moderate, very little in the dorsal, but in the lumbar it is considerable, more particularly in the lower. In the baboon the relation of the parts approaches that in man. In many animals which always move on all-fours a great change takes place; there may be a less or greater capability of bending the neck, but a much greater at the dorsal portion of the spine; and this is seen in a remarkable degree in the hedgehog, which draws the lower portion of the body towards the upper, when it becomes folded into a ball within the skin. In others the flexion of the dorsal vertebræ is for a very different purpose. In the sow it forms an arch, by which the weight of the young, the extensive mammæ, and capacious viscera, are better and more safely sustained. In others, as the jaguar, it allows the spine to be shortened in swift paces, and therefore the hind legs to be brought more forward at each spring than they otherwise could have been; in such instances there is very little motion of the lumbar vertebræ, which are required to afford a fixed point for the attachment of the muscles concerned in springing forwards. From the examination of the spinal cord in different animals it appears that its dimensions must be proportioned to the quantity of nerves required to proceed from it, and its largest portion must be placed where it cannot be subjected to undue flexion; and if it be contained in parts having extensive motions, as in the necks of some birds and the tails of various animals, it must have undergone a sufficient diminution in its circumference.

SPINAL NERVES.—There is a general resemblance of the spinal nerves in mammalia to those in man. They vary in number with the vertebræ, and in size and distribution with the extent and shape of the parts receiving them. The number of cervical nerves is the same as in man; the sub-occipital generally emerges from a foramen in the atlas, but in the rest there is not anything remarkable. The number of

dorsal nerves is seldom fewer but often greater than in man, and varies with that of the dorsal vertebræ and ribs; the number of lumbar, sacral, and caudal, varies with the corresponding portions of the spine; the anterior trunks of the lower sacral and caudal nerves form an anterior caudal nerve on each side, whilst the posterior form the posterior.

Each nerve, after the union of the anterior bundle with the posterior beyond the ganglion, is divided into an anterior and posterior trunk; the anterior is generally by far the largest, and furnishes many branches to parts situated near it, and enters into the principal plexuses, as the axillary, sciatic, and others; the posterior is generally small, but varies with the quantity of muscles and skin supplied by it. The nerves in all the mammalia are distributed to corresponding parts, but are larger or smaller according to the magnitude of the skeleton, or of particular organs.

In the fox, the sub-occipital nerve emerges from a foramen in the atlas; the anterior trunk passes forwards, and sends up two filaments to the junction of the trunk of the par vagum with the glosso-pharyngeal, the ninth, accessory, and the superior cervical ganglion of the sympathetic; it gives branches to the anterior straight muscles of the head, and then joins the slender descending branch of the ninth, to be distributed on the sterno-hyoid and thyroid muscles; the posterior trunk terminates on the posterior straight and oblique muscles. In the ass, several branches from the superior cervical ganglion of the sympathetic, in a plexiform manner, join the anterior trunk of the sub-occipital; the small descending branch of the ninth communicates either with the trunk or a filament from the par vagum, before it joins the anterior trunk of the sub-occipital; afterwards it communicates with the pharyngeal plexus, and is then distributed on the sterno-hyoid and sterno-thyroid muscles.

In the fox, the anterior trunks of the first and second cervical nerves give branches to the anterior straight muscles of the head, and then unite to communicate with the accessory, and divide into branches, which are distributed on the cutaneous muscle and skin, at the side of the face and neck and external ear. The third gives a branch to join the accessory and others to the trapezius muscle, and is then distributed on the cutaneous muscle and skin at the side of the neck. The fourth gives a branch to the

accessory and to the trapezius muscle, and then pierces this to terminate on the skin at the lowest part of the neck. The posterior trunk of the first cervical nerve gives branches to the splenius, complex, and other muscles, close to the posterior part of the spine, and then sends a branch through the complex towards the occiput, which gives filaments to the muscles inserted into the back of the ear, but is chiefly distributed on the skin of this part. The posterior trunk of the second, after giving branches to the splenius, complex, and other muscles, close to the posterior part of the spine, also sends a branch through the complex muscle to the skin of the occiput. The posterior trunk of the third gives branches to the complex and other muscles close to the spine, and then terminates on the skin. The posterior trunks of the fifth and sixth also give branches to the muscles and skin; the seventh was traced to the muscles only; the three last are much smaller than the preceding. In the fox, the phrenic nerve is formed of a branch from the fourth and fifth; it passes over the pericardium to the diaphragm, and on the right side is placed close to the inferior vena cava. In the ass, the nerve given to the great serrated muscle, proceeds from the fifth cervical nerve with the phrenic; but the phrenic afterwards communicates with a branch of the sixth, given to the great pectoral muscle. In the jaguar, the phrenic arises from the fourth and fifth cervical nerves, and receives a branch from the first thoracic ganglion of the sympathetic. In the fox, the axillary plexus is constituted of the three inferior cervical and the first dorsal nerves, but the greatest part of the fifth, after receiving a branch from the sixth, gives a large branch to the integuments on the anterior part of the shoulder joint, and then passes to form the superior scapular nerve, and terminate on the superior and inferior spinous muscles. Branches from the fifth, sixth, and seventh cervical, and first dorsal, are given to the pectoral muscles; a branch from the sixth cervical is given to the great serrated muscle, and branches from the fifth and sixth to the sub-scapular. A branch from the seventh cervical nerve passes down the side to the cutaneous muscle and skin, and communicates with the external branches of several of the dorsal nerves. The circumflex nerve arises from the union of the fifth and sixth cervical nerves, gives branches to the sub-scapular and teres muscles, and then divides and sends a branch to the inferior spinous muscle and the deltoid, and

branches to the integuments on the outer side of the arm. The internal cutaneous nerve is a slender nerve sent off by the ulnar; it passes down the arm, and, near the inner condyle of the humerus, divides into branches to be distributed on the skin at the ulnar side of the fore-arm. The smaller internal cutaneous nerve is the external branch of the second dorsal after its egress from between the ribs; it pierces the broadest muscle of the back, and divides into branches to be distributed on the skin at the inner and posterior part of the arm. The musculo-cutaneous nerve arises from the sixth cervical with the outer portion of the median, gives a branch to the pectoral muscle and the coraco-brachial, and then passes off to terminate on the biceps. The median nerve is thus formed; the sixth cervical having given off the nerve analogous to the usual musculo-cutaneous, the remaining part gives off a branch, which sends one back to the internal brachial muscle behind the tendon of the biceps, and then gives branches to the skin of the fore-arm, in the place of the cutaneous portion of the musculo-cutaneous in man; it then joins the branch from the seventh cervical and first dorsal nerves, about an inch above the elbow, to form the median nerve, which is small as compared with that in man; the nerve thus formed passes under the origin of the round pronator muscle, and gives branches to this, the radial flexor muscle of the wrist, and the sublime and deep flexors of the fingers; it then passes by the side of the radial flexor and between the sublime and deep flexors underneath the annular ligament; it is continued in the hand between the tendons of these muscles, at the division of which it sends off branches; it gives filaments to the skin of the palm, and a branch to the short prominence corresponding with the thumb and the inner side of the first finger, and a branch to be joined by one from the deep palmar for the outer side of the first finger and the inner side of the second; another branch also to be joined by a branch from the deep palmar for the outer side of the second and the inner side of the third. The ulnar nerve is formed from the seventh cervical and first dorsal, as well as the inner portion of the median; it descends behind the inner condyle of the humerus, covered by thick fascia and by part of the sublime flexor muscle; it then passes down the fore-arm between the flexors of the fingers and the ulnar flexor of the wrist; in the fore-arm it is much larger than the continuation of the median; it sends a branch

to the ulnar side of the sublime and deep flexors, and the ulnar flexor; near the hand it sends a branch to the back of this part to communicate with the radial branch of the spiral, and then proceed to the outer side of the last finger; it passes deeply, confined by a ligament at its entrance into the palm, and sends a branch for the inner side of the last finger and the outer side of the third: the rest of the nerve forming the deep palmar divides into branches, which terminate on the interosseous and other small muscles situated in the palm, and give branches to join those of the median, sent to the outer side of the first and the inner side of the second finger, and the outer side of the second and the inner side of the third. The spiral nerve has a slight communication with the fifth cervical, but is principally formed from the sixth and seventh and first dorsal; it gives branches to the different heads of the triceps muscle, and winds round between the inner and large heads of the triceps to the outside of the arm, and divides into two large branches; one gives off a large cutaneous branch to the outer side of the fore-arm, and then descends in the place of the radial, giving branches to the skin, and dividing to terminate on the skin at the back of the hand and the side of each finger, except the outer side of the last, and communicate with the dorsal branch of the ulnar; the other, in passing to the back of the fore-arm, gives a branch to the long and the short supinator; it is conducted between some fibres of the short supinator, and then divides to terminate in the radial extensor of the wrist and the extensor of the fingers, whilst a long branch passes on and gives filaments to the muscles analogous to the extensors of the thumb, and to the wrist-joint, but does not terminate on this part in a ganglion, as in man and the baboon.

The axillary plexus in the ass, also in the pig, is formed from the sixth and seventh cervical nerves and the first dorsal. In the jaguar, the axillary plexus is formed of the three inferior cervical and first dorsal nerves. In the ass, the superior scapular nerve proceeds more particularly from the sixth, but in some degree from the seventh, and is given to the superior and inferior spinous muscles of the scapula. Branches proceeding from all the nerves forming the plexus are given to the great pectoral muscle; a nerve proceeding principally from the sixth and seventh cervical nerves is given to the subscapular, the teres, and the broadest muscle of the back, and

then becomes the circumflex to pass outwardly to the muscle corresponding with the deltoid, and send a branch over the external head of the triceps, to pass down the arm to the skin. Branches proceeding from the external branches of the second and third dorsal nerves supply the skin of the arm like the smaller internal cutaneous. The internal cutaneous proceeds from the ulnar. The usual musculo-cutaneous arises principally from the sixth cervical nerve and a small branch of the seventh ; it sends a branch to the median ; it supplies and then pierces the coraco-brachial muscle to terminate on the biceps. The median nerve arises from the seventh cervical and first dorsal nerves, and receives a branch from the musculo-cutaneous ; it sends a branch on the outer side of the biceps, to supply the internal brachial muscle, and the skin at the posterior and inner part of the fore-arm, instead of the radial branch of the spiral, and the usual branch of the external cutaneous. The median, after supplying the flexor muscles placed in the fore-arm, sends a slender nerve close to the bone, which gives filaments to the periosteum, and passes to a muscle analogous to the long flexor of the thumb ; it then passes underneath the annular ligament, and sends a large branch obliquely over the flexor tendons, to communicate with the ulnar, and descends, giving off branches to the skin at the inner side of the foot, which communicate with the inner portion of the deep palmar of the ulnar ; it then passes into the foot covered by the membranous plaits attached to the hoof to terminate on these, the villous part of the sole and the ligaments of the joints. In the jaguar the median nerve passes through a foramen in the bone of the humerus with the humeral artery. In the ass the ulnar arises from the seventh cervical and first dorsal nerves ; at the middle of the arm it sends off the internal cutaneous nerve, and at the elbow gives some branches to the ulnar muscle and the elbow-joint ; it passes down, covered by some fibres of the flexor muscles ; and at the wrist sends off the dorsal branch to the skin at the posterior and outer part of the fore-arm ; it passes underneath and to the inner side of the ulnar flexor, and then underneath the annular ligament, and gives off the deep palmar nerve ; it receives the branch from the median and descends, giving branches to the skin and ligaments at the outer side of the foot, after these have communicated with the outer branch of the deep palmar ; it passes into the foot, covered by the membranous plaits

connected with the hoof, and terminates on these and the villous part of the sole and the ligaments of the joint. The deep palmar gives some filaments to the ligaments, and divides into two principal branches; one to pass on the inner side to give filaments to the joints, the periosteum, and ligaments, and communicate with the branches of the median sent to the skin and ligaments at the inner side of the foot; the other to give filaments to the periosteum and ligaments, and communicate with branches of the ulnar, having a similar destination on the outer side. The spiral arises from the sixth and seventh cervical and first dorsal nerves; after supplying the heads of the triceps, it passes round the humerus and gives branches to the two large extensors at the back of the fore-arm, and sends a branch somewhat expanded down to the carpal joints, but not like the ganglion in man; it then pierces the rudiment of the short supinator, to supply a muscle analogous to the long supinator on the outer side of the back of the fore-arm.

In the pig the median in the fore-arm is much larger than the ulnar, it receives a small communicating branch from the ulnar near the wrist, and then supplies the inner small toe, both sides of the first large toe, and the inner side of the second; the ulnar gives off the dorsal branch, and then sends the deep palmar to the interosseus muscles; it sends the small branch to communicate with the median, and then supplies the outer side of the second large toe and the adjoining small one. A branch from the deep branch of the ulnar passes between the outer large and small toe, and communicates with the dorsal branch of the ulnar, and is then distributed on the ulnar side of the back of the outer large toe and the adjoining small one. The greatest portion of the dorsum of the foot is furnished by the radial branch of the spiral and the rest by the dorsal branch of the ulnar. The spiral, from between the internal brachial muscle and the long supinator of the radius, sends off the radial branch for the back of the hand; it also sends off a smaller branch, which soon joins the radial branch. This smaller branch corresponds with the posterior cutaneous in man. The radial branch communicates with the external cutaneous branch of the musculo-cutaneous near the wrist; it then supplies the radial side of the outer large toe, both sides of the inner large toe, and the adjoining small one. The musculo-cutaneous nerve supplies and

then perforates the coraco-brachial muscle; it then supplies the biceps, and sends a long slender branch downwards to join a branch of the median; this junction supplies the internal brachial muscle, and sends off the external cutaneous branch, which gives branches to the skin as it passes down the fore-arm and hand, and at the wrist communicates with the radial branch of the spiral.

In the porpoise there are seven cervical nerves besides the suboccipital; there are twelve dorsal, eleven compared with the lumbar and sacral, and fourteen caudal. The suboccipital nerve passes out over the atlas and gives branches to cervical muscles, and then joins the first cervical and the large descending branch of the ninth. The first cervical nerve gives filaments to the muscle arising from the transverse process, which is the large scalenus, and then joins the suboccipital and descending branch of the ninth, to terminate on large muscles in the place of the sterno-hyoid; a branch of the first, joined by one from the second, passes between fibres of the trapezius to the integuments; another branch has a similar destination. A large branch of the second is given to the large anterior scalenus muscle. The third goes to the phrenic, after it has been joined by a branch from the junction of the fourth and fifth. The fourth and fifth unite and give off the supra-scapular nerve; this union is then joined to the sixth, and the junction of all these to the seventh and first dorsal for the axillary plexus. The posterior trunks of the cervical nerves give branches to the muscles and skin at the posterior part of the spine. The supra-scapular nerve is sent to terminate on the muscles of the scapula. The axillary plexus gives off numerous branches to the pectoral muscles, the teres, subscapular, and broadest muscle of the back; from the inferior part of the plexus a small nerve is sent to the great serrated muscle, and a much larger one downwards to the cutaneous muscle at the anterior part of the body. A large nerve similar to the spiral is sent to muscles in the place of the triceps, and to the teres muscle: there is a small median nerve given to the palm: the division of the ulnar takes place high up, one part goes to the outer edge of the palm, and the other to the back of the hand. There is not a circumflex nerve, neither an internal nor external cutaneous.

In the fox there are thirteen dorsal nerves, and their principal deviation from

those in man consists in a smaller size, a more direct course, and a less distribution on the abdominal muscles, and by those at the lower part of the chest being covered by an extension of the origin of the psoas muscle; and in the anterior cutaneous branches supplying the different portions of the mamma in the female dog as well as the skin: the posterior trunks, after supplying the muscles connected with the spine, and the sacro-lumbar and longest muscles of the back, send a branch between fibres of these and the broadest muscle of the back to the skin. The anterior trunks of the lumbar and sacral nerves supply principally the parts connected with the lower extremity, the bladder and rectum; the two superior of the posterior trunks of the lumbar supply the skin as well as the sacro-lumbar and other muscles connected with the posterior part of the lumbar vertebræ; the lower five the muscles only; the posterior sacral supply the muscles connected with the posterior part of the tail. The nerves are not very different from those in man except in their number, and consequently in their conjunction a little higher or lower for forming the nerves of the lower extremity. The anterior trunks of the three first lumbar nerves give filaments to the psoas muscle, and then pass forward to terminate in the abdominal muscles and skin. The fourth gives filaments to the psoas and internal iliac muscles, and sends a branch to join one from the third to form the external spermatic on the external iliac artery, which passes through the external ring to the spermatic cord; in a female dog this was distributed on the last division of the mamma; it sends off another branch which gives a filament to the external iliac artery and then joins the fifth, the rest of the fourth passes down on the exterior of the thigh to the skin, and forms the external cutaneous nerve. The fifth receives a branch from the fourth, gives filaments to the internal iliac muscle, part of it is then joined by a large branch from the sixth to form the anterior crural nerve; the other part after receiving a large and small branch from the sixth becomes the obturator nerve. The sixth having given off the preceding branches joins the seventh and the first sacral, and a branch of the second for forming the sciatic nerve. The junction of the seventh lumbar and first sacral, gives a branch to the pyriform muscle, and a larger one to pass out at the ischiatic notch to supply the gluteal muscles and the tensor of the fascia of the thigh. Some branches derived from the first and second

sacral nerves combine with the hypogastric plexus for supplying the bladder and rectum, and others from the pudendal nerves for the muscles connected with the anus and tail. A branch of the second sacral nerve joins the third for forming the anterior caudal nerve, which receives the anterior trunk of each remaining spinal nerve and passes deep in the anterior part of each side of the tail, giving off branches in its course; posterior trunks of the same nerves form a posterior caudal nerve, which also sends off branches to the posterior muscles and skin of the tail.

The anterior crural nerve passes between fibres of the iliac muscle, then under Poupart's ligament at the inner side of the sartorius, to which it gives branches also to the straight muscle, the external and internal vast muscles, and the crural, and sends off the saphenus, which, accompanied by a large branch of the femoral artery, as well as by the saphena vein, descends across the thigh to the inner part of the leg, communicates with a filament from the obturator, and is continued to the foot, giving filaments in its course to the fascia and skin. The obturator nerve on emerging from the pelvis gives branches to the pectineal muscle, the triceps and gracile, and sends a branch to communicate with the saphenus nerve; several fine branches pass down on the inner side of the thigh for the fascia and integuments. The sciatic nerve on emerging from the pelvis communicates with the internal pudendal; it sends a branch to the internal obturator muscle, and one which gives a filament to the upper portion of the geminous, and then passes behind the tendon of the internal obturator to the lower portion of the geminous and square muscles; the sciatic passes close to the insertion of the internal obturator muscle, and upon or behind the geminous and square muscles, then behind the trochanter covered by the origin of the biceps to which it gives a branch; it sends off a large branch which divides into others for the semimembranous and semi-tendinous muscles. About the middle of the thigh it separates into the posterior tibial and peroneal nerves. The posterior tibial nerve sends off a long slender branch which descends on the posterior part of the gastrocnemius muscle to the outer side of the leg, sends a branch behind the tendon of Achilles to the posterior tibial nerve, and is distributed on the skin at the outer side of the leg and heel. It then gives branches to the gastrocnemius muscle, and passes between the

heads of this and gives branches to the flexor of the toes, the posterior tibial and the long flexor of the great toe; it then passes down the leg on the inner side of the tendon of Achilles, and receives the branch from the long slender branch sent underneath this tendon. It passes behind the inner condyle of the tibia, and divides into the inner and outer plantar nerves; the inner plantar gives a branch to the inner side of the first toe, and then communicates with a branch of the deep plantar, and divides for the outer side of the first and the inner side of the second, it also communicates with a branch of the deep plantar given to the outer side of the second toe and the inner of the third; the outer plantar nerve passes between the flexor tendons, and sends a nerve to the outer side of the foot and the last toe; it gives off the deep plantar, which passes underneath the short flexor of the toes, and divides into branches, and gives filaments to each of the small muscles situated in the sole of the foot, and a branch to communicate with one from the inner plantar nerve and divide for the outer side of the first and the inner of the second, and one for the outer side of the second and the inner of the third, and another for the outer side of the third and the inner of the fourth. The peroneal nerve gives a small branch to the biceps and filaments to the fascia near the knee; it then divides, the anterior tibial nerve sends off branches to the anterior tibial muscle, the long extensor of the toes, and the long peroneal, and descends with the anterior tibial artery, underneath the annular ligament, and gives branches to the ligaments of the foot; it passes onwards, and is joined by a branch from the continuation or dorsal branch of the peroneal, and divides for the outer side of the first, and the inner side of the second toe. The continuation or dorsal branch of the peroneal gives branches to the short and third peroneal muscles, and passes behind the long peroneal, and emerges between this and the long extensor of the toes; it passes over the annular ligament, and sends a branch to the outer side of the foot and the fourth toe; on the back of the foot it sends the branch to join the anterior tibial nerve; it separates into two branches, the first divides for the outer side of the second and the inner side of the third toes, the other for the outer side of the third and the inner side of the fourth.

In the ass there are eighteen dorsal nerves, the anterior trunks of which pass

between the ribs, and are distributed nearly as in the fox. There are six lumbar and six sacral in one subject, and five lumbar and seven sacral in another, besides three or four caudal, but it is not necessary to speak of these separately. The third lumbar sends off a branch, which gives a branch to the great psoas muscle, and one to join the fourth for the anterior crural nerve, it then becomes the external cutaneous nerve to pass on the outer side of the thigh; it sends off another large branch corresponding with the external spermatic, which communicates with a large branch of the third lumbar ganglion of the sympathetic, gives a branch to the small psoas muscle, and then passes underneath the lower border of the abdominal muscles, to which it sends a branch and becomes distributed on the mamma. The anterior crural nerve arises from the third, fourth, fifth, and sixth lumbar nerves; the obturator arises from the fourth, fifth, and sixth; the sciatic arises from the sixth lumbar and the two first sacral, it has also a slight communication with the third; the principal part of the third and fourth sacral joined by a small branch from the portion of the sciatic arising from the second form a junction, which gives off the internal pudendal to pass at the side of the arch of the pubes and distribute filaments to the neck of the bladder, and terminate on the clitoris, vagina and external parts, and the connecting muscle and membrane between these and the mamma; a branch of the external spermatic may be traced downwards, and a branch of the internal pudendal upwards towards each other, but their communication was not made out; the rest of this junction communicates with another nerve formed by part of the fourth and fifth, and sometimes part of the sixth, branches are then given to muscles connected with the vagina, anus, and tail, and to the skin; another part of the junction of the fourth and fifth, with sometimes a branch from the sixth, joins the hypogastric plexus, and sends branches along the inferior uterine artery to the neck of the uterus and vagina, and is then distributed on the bladder, urethra, vagina, and rectum. The remaining part of the fifth or sixth sacral forms the beginning of the anterior caudal nerve, to which the anterior trunks of the remaining spinal nerves below it become united; the posterior trunks of these nerves form the posterior caudal nerve, both of these are continued to the extremity of the tail, communicating by branches, and supplying one-half of each anterior or posterior surface.

In the jaguar the anterior and posterior caudal nerves are formed in a similar manner, after these have received all the spinal nerves they are continued to the extremity of the tail, giving off branches in their course. In the ass the gluteal nerves are sent from the sixth lumbar and first sacral at their junction with the sciatic, and terminate on the gluteal muscles and the tensor of the fascia of the thigh. A nerve given off from the sciatic, supplies the slender geminous, and is continued down to another muscle approximated with the great head of the triceps; it is analogous to the square muscle, although it is so different in shape, and is supplied by the nerve always furnishing branches to the geminous. The anterior crural nerve supplies the sartorius and the other muscles in the place of the straight, the vast, and crural; the saphenus descends with the vein giving numerous filaments to the ligaments and skin, and communicating at the side of the foot with the inner branch of the deep plantar nerve, and through this with a branch of the inner plantar to be distributed on the skin at the side of the foot. In the jaguar the saphenus nerve is very large, and in the baboon it appears much larger in proportion to the size of the limb than in man. In the ass the obturator nerve supplies the adductors and the large muscle corresponding with the gracile. The sciatic nerve gives branches to the muscles which are in the place of the semi-membranous, semi-tendinous, and biceps; it then divides into the posterior tibial, and the peroneal, both of which give branches to the biceps. The posterior tibial sends a branch down at the back of the gastrocnemius muscle, and on the outer side of the tendon of Achilles to the fascia, &c., on the outer side of the heel or part corresponding with the heel bone; it then passes between the heads of the gastrocnemius muscle, to which and the large muscle in the place of the posterior tibial and the flexors of the toes it gives branches; it descends on the inner side of the tendon of Achilles, giving branches to the fascia, &c., on the inner side of the heel and ankle; near the heel it divides into the inner and outer plantar nerves; the inner sends off a large branch obliquely over the flexor tendon to join the external plantar nerve; it passes down on the inner side of the tendon, giving branches to the sheath, fascia, and integuments; near the foot it gives off a large branch, which communicates with the inner branch of the deep plantar nerve, to be distributed on the skin at the

inner side of the foot; it gives branches to the skin of the heel, and then passes into the foot, covered by the membranous plaits connected with the hoof, and distributing branches to these and the villous covering of the sole. The external plantar passes between the flexor tendons, and then on the outer side of these, and gives off the deep plantar nerve; it is continued down on the outer side of the tendon, gives filaments to the sheath and fascia, receives the branch from the inner plantar, and gives off a branch which communicates with the outer branch of the anterior tibial nerve, and is distributed on the side of the foot; it gives branches to the skin of the heel, and then passes into the foot covered by the membranous plaits connected with the hoof to distribute branches to these and the villous covering of the sole. The deep plantar gives filaments to the ligaments, &c., and then divides into two branches; the inner passes down underneath the tendon, then near the edge of the bone to the foot to communicate with a branch of the saphenus nerve, and of the inner plantar, to be distributed on the skin at the inner side of the foot; the outer branch passes near the edge of the bone, gives a branch to the ligaments, and then joins the outer branch of the anterior tibial nerve. The peroneal nerve passes to the outer side of the leg, and gives small branches to the fascia and skin; it sends the long branch downwards, which gives filaments to the fascia, and terminates in the skin covering the dorsum of the cannon bone. It gives filaments to the ligaments and fascia on the outer side of the knee joint, and branches to the peroneal muscle, the extensors of the toes, and the anterior tibial muscle. It gives off the anterior tibial nerve, which passes down the leg between the peroneal and anterior tibial muscles, then between this and the bone along with the anterior tibial artery underneath the annular ligament, where it divides into two branches, the outer one gives filaments to the joint, and is continued with the anterior tibial artery on the outer side of the cannon bone, giving filaments to the periosteum, and on the outer side of the foot receiving the outer branch of the deep plantar nerve: it then becomes connected with a branch of the outer plantar nerve, and is distributed on the ligaments and skin on the outer side of the foot; the inner branch of the anterior tibial passes down on the cannon bone, gives filaments to the periosteum and fascia, and terminates on the skin at the inner side of the foot.

In the pig the posterior tibial nerve having given branches to the muscles of the leg, and sent the branch down at the back of the gastrocnemius muscle to the outer side of the leg, gives filaments to the inner side of the heel, and near this part divides into the inner and outer plantar nerves; the inner is continued onwards and supplies the small inner toe, and the first large toe, and the inner side of the second. The outer plantar passes underneath the flexor tendons, and is continued onwards to divide for the outer side of the second large toe, and the outer small toe; it sends the deep plantar into the sole to supply the short muscles situated there. The anterior tibial nerve gives branches to the ligaments at the back of the foot, and sends a branch to supply the first small toe and the inner side of the first large one; the rest of it gives branches to the small muscles on the back of the foot, and then passes forward to join the branch of the peroneal given to the outer side of the first, and the inner side of the second large toe; the continuation of the peroneal, after emerging just above the instep, supplies the outer side of the first large toe, both sides of the second, and the last small one, the branch sent to the outer side of the first and the inner side of the second large toe, receiving a branch of the anterior tibial.

In the porpoise the distribution of dorsal nerves is similar to that in mammalia. The external divisions of the anterior trunks of the dorsal nerves are extremely small, being mere branches and not a division of the trunk as in man, but the whole continues progressing forwards, and giving off small branches in its course to the intercostal muscles, the abdominal muscles, and skin; the three upper ones supplying the triangular muscle of the sternum. The posterior trunks supply the muscles and skin at the posterior part of the spine. There are eleven that may be compared with the lumbar and sacral, and from the lowest of these the anterior caudal trunk begins. The remaining fourteen are entirely caudal. Each of nine of the upper lumbar and sacral give off a considerable branch near the spine to the psoas muscle. The five uppermost pass forwards, giving off filaments to the psoas muscle, and then reach the muscles at the anterior part of the abdomen, and distribute filaments in their course. Branches given off from the next six terminate in the psoas muscle, the lowest five then form the internal pudendal nerve, but, like the rest, send forward a smaller branch

to the muscles. There is not either an anterior crural, obturator, or sciatic nerve; there is a large one resembling the internal pudendal; it arises in the male and female from five nerves corresponding with the lumbar, and the lowest also forms the beginning of the anterior caudal trunk; it passes forwards, and in the male sends branches underneath the pudic bone to the muscles connected with the penis; one passes to the muscles and skin connected with the anus; others pass over the pudic bone to the muscles of the penis; a branch passes upwards towards the bladder, and its ramifications are joined by others from the hypogastric plexus, for the bladder and parts connected with its neck; the pudic nerve then passes forwards on the penis, distributing branches over its surface, some of which penetrate its tendinous parietes, whilst one or two pass underneath the prepuce to terminate about the glans. In the female a branch joins others from the hypogastric plexus for the bladder and vagina; it then forms two principal divisions: from the first, several are sent over the pudic bone to the muscles and integuments of the vagina and its orifice, and one passes to the mamma; from the second division the largest branch passes upwards to the superior angle of the orifice of the vagina, to be distributed about the clitoris, the smallest to the muscles and integuments at the lower part of the vagina. Each caudal nerve on passing out of the spinal canal gives a branch to the anterior and posterior caudal trunk, which are of considerable size, for supplying the large muscles and integuments of the anterior and posterior surface of the tail. The posterior caudal trunk has a conjunction with seven superior sacral and lumbar nerves, which the anterior has not. From each anterior caudal trunk branches pass anteriorly and laterally; from the posterior caudal nerve a branch passes obliquely towards each spinous process; another branch passes obliquely and then transversely in the direction of each transverse process for supplying the muscles and skin. The anterior and posterior caudal trunks become smaller as they reach the tail, and then divide for supplying respectively the anterior and posterior flat surfaces. Although the animal lives in water, the large tail is supplied by nerves arising at a very great distance above its extremity, and not from nerves proceeding directly from the spinal cord, continued throughout the canal of the caudal vertebræ, as in birds, amphibia, and fishes. The large nerves of the tail

exist more for conferring muscular power than sensation, and the portions reaching the broad flat surface on the extremity are very diminutive; it therefore appears that the tail is not only a powerful instrument for motion, but for defence, and that it is capable of giving hard blows without feeling much pain; it is on this account furnished with just as much nerve as will produce a moderate perceptiveness, something between that of skin and horn.

The number of cervical vertebræ being always the same in mammalia, when the neck is long the nerves are placed at a proportionately greater distance from each other; if therefore the four inferior had always entered the axillary plexus, as in man, some of them must have been conducted to it in a manner quite incompatible with the free motion of the spine and the upper extremity; so that it is generally composed of fewer and larger nerves, and so long as there is the same regularity in the origin of the fibrils from the spinal cord, their collection into few or many nerves, or into larger or smaller, is of no importance, for in the hedgehog the whole body receives its nerves from a spinal cord, occupying only a small part of the spinal canal. In the fox, the two cords forming the median nerve do not unite at the upper part of the humerus, as in man, but at the lower, at a very acute angle; there is, however, some variation in different subjects, and even the two limbs of the same.

In simiæ, the nerves of the palm of the hand are small in proportion to those in man, and do not terminate in such thick brushes of filaments at the tips of the fingers, and therefore are not near so well calculated for perfecting the sense of touch. They are, however, a little larger than those of the foot. The nerves derived from the radial branch of the spiral, and the dorsal of the ulnar, supplying the back of the hand and fingers, are much larger in proportion to the same in man. The sense of touch in different animals is variously modified by the shape of the foot, as well as by the structure of the skin, and is frequently so much altered as to possess merely common feeling. In many animals, as the anterior extremities exist principally for supporting the body, the large branches of the fifth spread on the snout answer the purpose of the sense of touch, but are smaller when the nerves of the fingers approach the proportion of those in man.

In the part of the ass corresponding with the hand and foot there are not any muscles, but only tendons, ligaments, and integuments; all the same nerves are nevertheless continued into the foot, as in other animals, but terminate in a single toe, instead of the four or five of other creatures, the difference consisting in their not being so much subdivided. This disposition obviates the compression to which fewer and larger nerves would be exposed, and in accidents secures the integrity of some; it also produces a sufficient consent between the different textures of the foot and the various muscles belonging to the limb, and thus the whole contribute to the free and forcible direction of the foot, and particularly its firm position on the ground. Where there are several toes, still this association with all the muscles of the limb, with some modification, is required; and when there are several fingers, as in the human hand, it is necessary for perfecting the sense of touch, and all nice operations connected with this faculty.

In some animals, as in man, a ganglion is attached to the termination of the spiral nerve at the back of the wrist for supplying the carpal joints, and an enlargement or expansion of the outer branch of the anterior tibial below the annular ligament for the tarsal. In the baboon, there is a ganglion for the carpal, but only a flat brush of filaments, without any appearance of the ganglion for the tarsal. In the jaguar, there is a very slight enlargement of the nerve for the carpal and tarsal, but not a ganglion. In the fox, there are only filaments for both the carpal and tarsal joints proceeding from the nerve, and not from a ganglion. In the ass, the one for the carpal joint is broader than the nerve, but has not a ganglionic appearance, nor has the branch of the anterior tibial for the tarsal. As the joints are generally supplied by ordinary nerves, the ganglion may only form a close union with the ligaments for sending off its branches more safely, when these joints are subjected to complicated movements.

SYMPATHETIC NERVE.—In the sympathetic nerve of different genera and even species of mammalia there are peculiarities. The superior cervical ganglion varies somewhat in its shape, but is generally pyriform, or oval, and in many instances corresponds in bearing a proportionate size to that of the second trunk of the fifth;

thus it varied with this nerve in three species of the dog. In simiæ the superior cervical ganglion is rather pyriform, the Vidian nerve is connected with the indistinct representative of the spheno-palatine ganglion in man, and divides into two branches; the superior to join the hard portion of the seventh, and the inferior to join the sympathetic in the carotic canal. In other animals the greatest portion of the sympathetic ascending from the superior cervical ganglion passes to the part of the Gasserian ganglion giving off the first and second trunks of the fifth. In the dog the superior cervical ganglion is pyriform, and less than it usually is in man; branches ascend to join the fifth and sixth nerves, and one branch corresponding with the Vidian proceeds forwards to form a ganglion on the floor or the inferior surface of the orbit, just at the inner side of the second trunk of the fifth, and join the nerve arising from this, and dividing into the lateral nasal and palatine. In the jaguar the superior cervical ganglion is thick and pyriform, it sends filaments upwards, which communicate with the glosso-pharyngeal, and the conjoined par vagum, accessary and ninth; it sends off the Vidian nerve, which forms a ganglion on the floor of the orbit, at the inner side of the second trunk of the fifth nerve, and is intimately connected with the lateral nasal nerve, but communicates in an indirect manner with the palatine nerve; the ascending prolongation passes over a considerable part of the petrous portion of bone in many filaments, some of which communicate with the tympanine branch of the glosso-pharyngeal, but the greatest number creep over this bone to the fifth nerve, whence a branch is sent to join the hard portion of the seventh; many of the filaments appear to be continued on the inferior surface of the Gasserian ganglion, and some to communicate with the sixth, and others to be extended to the rete mirabile. The superior cervical ganglion below communicates with the first cervical nerve, the pharyngeal plexus, and the laryngeal nerve, and sends branches on the ramifications of the external carotid artery, and then gives off the prolongation to be loosely attached to the trunk of the par vagum. In the calf the superior cervical ganglion is thick and oval; it sends a branch into the tympanum to join the tympanine nerve; it communicates with the sixth, and by a branch with the hard portion of the seventh, instead of the superior branch of the Vidian as in man, whilst the Vidian, which

corresponds with the inferior branch only in man, passes to the lateral nasal nerve of the second trunk of the fifth, with which it forms a ganglionic union; filaments are also sent towards the par vagum, the glosso-pharyngeal and ninth at their exit from the cranium; there is another ganglion connected with a portion of the third trunk of the fifth, termed by Arnold otic; it may also be well seen in the sheep. The otic ganglion communicates with the buccal, and the trunk giving off the gustatory and inferior dental nerves, and sends a branch to the internal pterygoid muscle; it sends a branch along the Eustachian tube, where it divides into two, one of which joins the branches of the sympathetic in the tympanum, the other terminates on the tympanum. From the superior cervical ganglion branches proceed to the pharyngeal plexus, and along the carotid artery, for supplying the coats of the branches of this and also the salivary glands. In the sheep the superior cervical ganglion is oval, two small and two larger filaments ascend from it, and appear to form a plexus, from which the Vidian passes to the lateral nasal nerve, and two branches to the Gasserian ganglion, with which they become incorporated. In the ass the superior cervical ganglion is longer, but not so thick as in the calf, and resembles very much that in man; branches ascend from it, which form a plexus round the internal carotid artery; some filaments are connected with others from the glosso-pharyngeal to be distributed on the membrane lining the tympanum; the principal portion turns forward at an acute angle, and is joined by others, it then gives off filaments to the second trunk of the fifth and the sixth, and to the hard portion, whilst the Vidian passes forward at the inner side of the Eustachian tube, and then passes in a bony canal a short distance, and joins the nerve arising from the second trunk of the fifth, which divides into the lateral nasal and palatine, but it does not form a ganglion; below it communicates with the par vagum, accessary, ninth and sub-occipital, and gives branches to the carotid artery and the pharyngeal plexus. In the pig the branches ascending from the superior cervical ganglion may be traced to the second trunk of the fifth and the sixth nerve; there is not a distinct Vidian nerve passing in a canal of bone, as in the calf and ass, but the branch most resembling it can be traced on the second trunk of the fifth to the place whence the palatine and lateral nasal nerves proceed; the other branches

proceeding from the superior cervical ganglion communicate with the ninth and sub-occipital nerves and the pharyngeal plexus, and send a very large branch on the carotid artery for supplying the salivary glands, and other parts on which the arterial branches are distributed. In the porpoise the pyriform superior cervical ganglion of the sympathetic nerve sends one portion upwards; the prolongation is continued downwards, and just below the superior cervical ganglion communicates with the superior laryngeal nerve; at the lower part of the neck, the prolongation terminates in the second or inferior cervical ganglion; on the right side, but not on the left, this communicates with the par vagum at the place from which the superior cardiac nerve is given off; there is also another communication of the par vagum with this ganglion.

The prolongation from the superior cervical ganglion is usually a small cord; in the baboon and monkey generally, but not always, and in the hedgehog and rabbit it passes down the neck to the inferior cervical and first thoracic ganglia, without any intimate attachment to the trunk of the par vagum, and distributes branches in its course, but in the baboon it sometimes forms a close union with the nerve for about a third of an inch, just below the superior cervical ganglion. In the pig, it only just joins the par vagum on the right side, and for a very short distance on the left, before it passes to the inferior cervical ganglion, which is quite separate on the right side, but joined to the first thoracic on the left. In many animals, as the jaguar, dog, fox, ass, calf, and goat, the prolongation through the neck is attached to the trunk of the par vagum, and in the calf has sometimes very small ganglia imbedded in it, which give filaments to accompany small arteries; it leaves the trunk of the par vagum sooner or later at the bottom of the neck to form the inferior cervical ganglion, and become connected with the first thoracic. There is a plexus on each side of the neck continuous with the cardiac nerves in the baboon and rabbit, but it is not so complicated as in man; it receives from the superior cervical ganglion a slender branch, which is joined by a filament from the superior laryngeal nerve, and at the bottom of the neck by other branches from the sympathetic, the par vagum, the recurrent, and phrenic: communications then take place between the nerves of the two sides, and branches are sent to the heart, those connected with the right side

principally accompanying the left coronary artery, and those with the left, the right. In the calf, the prolongation passes to a very small ganglion from the trunk of the par vagum, and from this nerve and the first thoracic ganglion the principal portion of the superior cardiac nerves is sent off to the auricles and ventricles; the inferior cardiac nerves arise from the thoracic, and will be described further on. In the ass, the sympathetic passes from the trunk of the par vagum nearly as in the calf, but the right inferior cervical ganglion is rather larger, and the left extends to the first thoracic; distinct communications exist between branches from the first thoracic ganglion, the phrenic nerve, and the trunk of the par vagum; the inferior cervical and first thoracic ganglia communicate very much with the recurrent nerves and some branches of each trunk of the par vagum, so as to form a plexus, from which branches proceed to the heart, those of the right side prevailing for the left ventricle, and those of the left for the right; others, joined by branches from the trunk of the par vagum, are given to the auricles. In the jaguar, the sympathetic, on leaving the trunk of the par vagum, passes to the inferior cervical ganglion, which on the right side forms a small ganglion, and a still smaller one on the left; these send off branches to encircle the subclavian artery, and join the first thoracic ganglion, and give off cardiac branches, which, together with others from the first thoracic ganglion and the trunk of the par vagum on each side, form communications with the recurrent nerves: the branches then pass principally to the ventricles; other branches from the trunk of the par vagum and recurrent, which have communicated with some of those given to the ventricles, pass to the auricles, but some of these are also extended to the ventricles. Branches from the first thoracic ganglion join the par vagum, the recurrent and phrenic nerves. In the dog and fox, the inferior cervical ganglion is intimately connected with the trunk of the par vagum; it is placed at the inner side of the first thoracic, the short prolongation passing from one to the other over and under the subclavian artery, it sends off branches to join others from the thoracic ganglia, from each trunk of the par vagum and the recurrent, for supplying the heart; in the fox, it appears almost as if a large branch issued from the first thoracic ganglion to join the trunk of the par vagum, and for many of the cardiac nerves to pass off after this

junction. In the dog, communications between each inferior cervical ganglion and phrenic nerve can be traced. In different animals, the cardiac nerves arise higher or lower according to the position of the heart, and although altogether bearing a considerable resemblance to those in man, neither form such distinct plexuses for the auricles and ventricles, nor a cardiac ganglion, nor distribute so many branches on the large bloodvessels. The size and mode of distribution of the cardiac nerves may be well observed in the heart of the ox very soon after it has been killed, and before the pericardium has become dry: for then every nerve as it passes down on either surface of the heart is accompanied by a vein on each side, by which its breadth is defined. A large absorbent vessel adheres to the front of the nerve, and it is supplied by small arteries in its course from the subjacent vessels. The nerves appear as white lines passing obliquely over each surface, and those of the left ventricle much larger than those of the right. The vein on each side of every nerve is like a thick hair or bristle, and frequently communicates with those accompanying the neighbouring nerves; the large absorbent vessel on the surface of each nerve becomes very plain after the maceration of the heart in water. The arteries of the nerves are discovered with much greater difficulty, and only after a very minute injection by the coronary arteries. By crossing the muscular fibres and the arteries, the artery of every nerve in its course becomes replenished with blood from branches of different subjacent arteries, and at the same time by this oblique course each descending portion of the muscle derives its nervous filaments from different nerves. By this adopted plan of making the nerves cross the arteries and muscular fibres, every nerve is secure of having its due quantity of blood, notwithstanding the imperfect functions of any particular artery it crosses; any considerable portion of muscle, therefore, cannot have its activity checked. In the porpoise, part of the prolongation passes over, and the rest underneath, the subclavian artery to the first thoracic ganglion, which is large; it sends a branch on each side to join the recurrent nerve, and branches upwards to the cervical nerves and downwards to the vascular rete on the ribs. The cardiac nerves on the right side begin by a branch from the second cervical ganglion; it communicates twice with the trunk of the par vagum, and then passes behind the

arch of the aorta and sends some filaments to join others from the left trunk of the par vagum and pass on the posterior part of the pulmonary artery, with the right coronary artery, to the right ventricle; it then passes to the front of the pulmonary artery, with the left coronary artery, to the left ventricle. From the first thoracic ganglion small branches are sent along the superior vena cava to the right auricle. From the trunk of the par vagum a branch is sent to the right auricle. On the left side a branch is sent from the second cervical ganglion, it communicates with the recurrent, and terminates principally on the aorta and pulmonary artery. Small branches, as on the right side, are sent from the first thoracic ganglion to the pericardium and left auricle, but some reach the left ventricle. The left trunk of the par vagum gives off a branch which sends filaments to the aorta and pulmonary artery, and to join filaments from the first cardiac nerve of the right side; another branch is sent off by the left trunk of the par vagum to the pulmonary artery and left auricle.

The subclavian, or other large artery arising from it, and giving off the vertebral, is generally embraced by branches passing from the inferior cervical to the first thoracic ganglion, and one or more branches are always sent up from one or both of these ganglia along with, and giving filaments to, the vertebral artery, and forming in many instances the only communication with the cervical nerves; but there is not a ganglion at each point of union, as in birds. In mammalia, the small proportion of the communicating branches of the sympathetic to the cervical nerves is very remarkable, when compared with those connected with the dorsal. The thoracic portion of the sympathetic supplies nearly the same parts as in man; in the jaguar, branches from several of the thoracic ganglia of the right side unite and communicate with the right posterior pulmonary plexus, and then cross the spine to receive similar branches from the thoracic ganglia of the left side, after their communication with the left posterior pulmonary plexus; thus a great resemblance to the thoracic plexuses in man is formed. In the calf, a similar plexus gives off the more inferior cardiac nerves to the left auricle and ventricle; it proceeds from four or five of the thoracic ganglia on the right side, and forms communications with the anterior cord of the par vagum, which sends branches to the lungs before it descends to the stomach; branches extend

across the spine behind the œsophagus, and communicate with some from a similar plexus on the left side, whilst others pass behind the inferior vena cava, and give branches to the left auricle and ventricle, and near the azygos vein become connected with the left thoracic plexus, which also gives branches to the left auricle and ventricle.

In simiæ, the jaguar, dog, fox, hedgehog, and rabbit, the prolongation is a thick and narrow cord similar to that in man, but in herbivorous animals, as the ass, calf, and goat, it is broad and flat, and composed of parallel threads communicating with each other; in the pig, its disposition is more close, but it is broader and less compact than in the dog, jaguar, and others, and contains similar close and fleshy ganglia; in the calf, small ganglia are imbedded in it, which in the ass rather form an areolar disposition of some of the threads; near the bottom of the chest, however, two or three small fleshy ganglia are observed; on the inner side, these ganglionic spots give filaments to the aorta, and, on the outer, communicate with each intercostal nerve; in the ass, it continues of almost the same breadth nearly throughout the thorax, but above the last rib but four begins to separate from the splanchnic nerve, to which, however, it adds fresh branches; in the calf, after the thoracic plexus is given off, it becomes narrower; it then, in descending, gradually gets broader after its communication with each intercostal nerve, and appears rather to have had a branch added to it by, than to have given one to, each intercostal nerve. Although the splanchnic nerve adheres so closely to the prolongation, it may, by a careful dissection, be separated from this, and resolved into the several cords of origin very similar to those in man, but not without dividing connecting filaments. It passes through the diaphragm to the semilunar ganglion, and forms a close union with the renal capsule, and then sends off the prolongation. The thoracic portion differs in several animals as to its manner of giving off the splanchnic nerves. In the baboon and hedgehog, but not in the monkey, the splanchnic nerve forms a plexus on the sides of the bodies of the vertebræ, which is very similar to that in man; and in the baboon the right arises from two ganglia higher than the left, and extends over the heads of seven inferior ribs, the left over only five; each expands into a small ganglion at the bottom

of the chest, and that of the left side forms a junction with the prolongation, but becomes again separate before it passes through the diaphragm; in the hedgehog, the splanchnic nerve extends over the heads of the four last ribs; it receives fresh branches from the sympathetic as it descends to the semilunar ganglion, thus forming a plexus on the sides of the vertebræ, in some measure similar to that in the baboon. In the monkey, the splanchnic nerve separates from the prolongation lower down than in the hedgehog, just below the last rib. In the jaguar, the splanchnic nerve leaves the prolongation a little above the diaphragm, and passes to the semilunar ganglion. In the pig, the prolongation, just at its passage through the diaphragm, sends off the splanchnic nerve and forms a ganglion, from which a branch is sent to the last dorsal nerve. These variations of arrangement do not seem to make any difference, either in the formation of the semilunar ganglia or the branches proceeding from them. In the baboon, there is a distinct communication between the right phrenic nerve and semilunar ganglion. In the porpoise, the thoracic ganglia are well developed, and, on the whole, larger than in mammalia; they send branches inwardly towards the aorta and to form the splanchnic nerves, and outwardly to the vascular rete, besides others to the spinal intercostal nerves: the ganglia of the lower thoracic portion are smaller than the upper; towards the lower part of the thorax the prolongation passes behind the psoas muscle.

The renal capsules and semilunar ganglia are of various shapes in different animals, and in the two sides of the same; there is frequently an intimate union between these and the splanchnic nerves, sometimes by fleshy ganglion, sometimes by a fibrous membrane or filaments; but it is not the same always in each species. In simiæ, each semilunar ganglion is composed of a dense membrane and some fleshy parts, but the fleshy parts are not near so large as they generally are in man; in the jaguar, a considerable portion is fleshy, and the rest a dense membrane; it is nearly the same in the dog and fox; in the ass, a small portion is fleshy and the rest membranous, but the fleshy part is not of so dense a texture as in man; in a full-grown sow, it is formed of a very delicate membrane, with some small patches of fleshy ganglion amongst it, which are much less than in the ass; in the hedgehog, it is membranous

and fleshy. Each semilunar ganglion assists in forming plexuses, consisting of branches connected together in some instances by a very delicate or dense membrane, or a more fleshy substance, and are more or less extensive according to the magnitude or length of corresponding portions of the viscera, but the general disposition of the whole is very similar to that in man. Some branches pass on the arteries of all the stomachs of ruminating animals, as they do on those of the single one in others. The hepatic, splenic, renal and spermatic plexuses, are very similar to those in man, but generally not quite so intricate, and there are similar connexions with branches of each trunk of the par vagum. When the duodenum is longer, more branches pass from the superior mesenteric plexus with the branch of this artery, to meet those proceeding from the hepatic plexus on a branch of the right inferior gastric artery; in the jaguar, branches from the superior mesenteric plexus were distinctly traced to several parts of the large mesenteric gland; in other respects, in mammalia generally, the distribution of the superior mesenteric plexus is very similar to that in man, in furnishing the small intestines, and the beginning of the large, with branches, but in being larger or smaller according to the different capacity and extent of the canal, and as it supplies the cœcum and the extensive loose portion of the colon in the ass, it appears to preponderate very much more over the inferior mesenteric plexus than it does in some animals. In the ass, the cœcum, and about six feet and six inches of the colon, were supplied by the superior mesenteric plexus, and about two feet and six inches by the inferior; in the baboon, the cœcum, and about one foot of the colon, were supplied by the superior, and about five feet by the inferior; in the fox, about eight inches of the colon were supplied by the superior, and six inches by the inferior. It is difficult to state the precise boundaries of the termination of the superior, and the commencement of the inferior, as the two meet and communicate. But in the ass the superior supplied a much larger portion than the inferior, as compared with the same in the baboon. In the porpoise, from the ganglion in the eighth intercostal space the great splanchnic nerve begins, it passes down a considerable way; from the prolongation and ganglion in the ninth intercostal space another large branch passes down and joins the preceding near the diaphragm and passes between fibres of this

to the semilunar ganglion; from the ganglion in the tenth intercostal space another branch is given off, it soon joins the second, principally by cellular tissue, but does not appear to have much communication with it; the third is soon joined by a fourth from the eleventh intercostal space; it communicates with the great splanchnic and then passes through the diaphragm; these branches coalesce into an expansion which is thin at the upper part and thicker and narrower below; it is very much connected with the renal capsule; it sends branches on the diaphragm expanded into a broad and thin semilunar ganglion; from its lower part two large branches are sent to the kidney. The semilunar ganglion, which is similar in structure to that of the pig, communicates on each side with the anterior cord of the par vagum, and on the left with small branches sent from the posterior cord of the par vagum; it sends branches with the divisions of the cœliac artery, which has a long trunk, and, with the splenic artery, to the pancreas, spleen, and first or cuticular stomach; with the hepatic to the liver; and with a branch of the hepatic to the fourth stomach, or second duodenal pouch, which meets a branch of the superior mesenteric supplying the fifth stomach, or third duodenal pouch: this branch of the superior mesenteric also sends a branch to the liver; the rest of the cœliac artery, which may be called coronary and is its principal part, passes chiefly to the second or villous stomach, but also gives some branches to the third stomach, or first duodenal pouch, and to the first or cuticular stomach; this also receives branches from the phrenic and from the splenic already mentioned, and on the branches of the cœliac artery, branches from the semilunar ganglia are sent to the viscera. The principal portion of the branches from the semilunar ganglia passes with the superior mesenteric artery, and separates to be conducted on branches of this to supply the large mesenteric glands and the intestines. Besides the numerous branches sent along the mesenteric artery to the upper portion of the intestines, others proceed from the inferior part of the semilunar ganglia, which pass rather more than an inch to an oval ganglion of considerable size, placed in the mesentery; branches of this communicate on branches of the mesenteric artery as they pass to the upper portion of the intestines; the rest pass in the inferior part of the mesentery, and are joined by others from the inferior part of the semilunar ganglia,

and accompany the descending branch of the mesenteric artery to the lower portion of the intestines. The principal portion of the lower splanchnic nerve gives off two large branches for the kidney, these divide and follow the ramifications of the artery into each lobe; and although the lobes are separate, the nerves cannot be traced much more satisfactorily than in a solid kidney.

The lumbar portion of the sympathetic usually gives off several nerves, generally branches from the inner side of the three or four superior ones communicate with the semilunar ganglion, the renal, spermatic, aortic, and hypogastric plexuses; these and the rest of the lumbar ganglia, and the sacral, on the outer side, communicate with corresponding spinal nerves, sometimes with more than one, and on the inner give branches to the bloodvessels, the ligaments of the spine, the cellular membrane, and absorbent vessels and glands. In the baboon and ass, the three first lumbar ganglia of the sympathetic send branches to the semilunar ganglia, the renal, spermatic, and aortic plexuses; also in the fox, but they are, in this animal as well as the jaguar, very slender. Each prolongation, towards the bottom of the sacrum, forms one or more points of union, but coalesces on the caudal artery, from which nerves are continued for the purpose of supplying the coats of this vessel: in the calf, each prolongation terminates on this vessel in the single ganglion, from which a prolongation is continued; in the jaguar, each prolongation was traced into the tail, to be ultimately distributed on this artery. In the porpoise, the prolongation is continued through the lumbar region behind the psoas muscle; it forms a ganglion and communicates with each spinal nerve; near the tail it passes forwards and gets into the canal formed by the inferior arches of the vertebræ, and is continued onwards with the caudal vessels for their supply, and on which it forms frequent communications with its fellow. There are ganglia belonging to the dorsal portion of the prolongation and three distinct ones to the beginning of the lumbar, which send branches to the four first lumbar nerves; below these there are not any distinct ganglia in the prolongation, but from this branches are sent to the fifth, sixth, and seventh lumbar nerves; to the next five, constituting the internal pudendal and the caudal, the filaments communicating with the spinal nerves are very small.

The aortic plexus varies with the capacity and extent of the large intestines, at a greater or less distance below the cœcum, and receives proportionate branches from the lumbar ganglia; after giving off the spermatic plexus, it generally divides into the hypogastric plexuses, which become combined with branches of sacral nerves, nearly as in man, for supplying the bladder and rectum, and in the female the vagina likewise.

In simiæ, the aortic plexus is nearly the same as in man, and forms a large membranous plexus, and appears most extraordinary when compared with that of animals generally; the termination giving off the hypogastric plexuses is a broad portion of the same. In a female jaguar, the aortic plexus gives off the spermatic plexus for the ovary and uterus; at its inferior part it forms a considerable ganglionic enlargement, which gives off branches to form the inferior mesenteric plexus, and then sends off the hypogastric of each side to join branches of the first and second sacral nerves for supplying the bladder, vagina, and rectum, branches extending near to the orifice of the urethra and vagina, whilst the sphincter of these canals is furnished by branches of the internal pudendal nerve. The aortic plexus in the male dog and fox is very similar to that in the female jaguar, and forms at its inferior part a similar ganglion for giving off the inferior mesenteric and hypogastric plexuses. In a female ass, the aortic plexus is broad, and has a particular membranous appearance: the external spermatic nerve supplies the mamma, it arises from the third lumbar nerve, and communicates with the third lumbar ganglion of the sympathetic, from which a large branch is sent to the aortic plexus, and at this point of union the internal spermatic nerve is given off to the ovary, the Fallopian tubes, the round ligament and uterus; the lower part of the aortic plexus, before its giving off the hypogastric, appears to be of a structure between the thick membrane of that in the baboon and the ganglion in the sow. In the sow, the aortic plexus is rather membranous and delicate; it gives off the internal and superior spermatic nerves, which pass on the broad ligament principally to the ovary and Fallopian tube; it then, on each side, forms a large ganglion, joined to its fellow by a bridge; from each ganglion branches are sent with the inferior mesenteric artery to the lower portion of the colon; it then gives off an inferior spermatic plexus to accompany the large uterine artery, and

ramify in the broad ligament with branches of this, in a similar manner to those in the mesentery, to be distributed on the horn of the uterus; the ganglion then sends down the hypogastric plexus to join branches of the sacral nerves. In the porpoise, small branches are sent from the semilunar ganglia to the aortic plexus, and this keeps receiving fine branches from the prolongation and ganglia, which pass through a tendinous fascia, and are therefore with much difficulty followed; below the seventh lumbar vertebra the filaments sent to the aortic plexus are extremely minute. The aortic plexus sends filaments in the portion of mesentery corresponding with the mesocolon towards the lower portion of the intestines; it is then continued down to the large ganglion of the hypogastric plexus, which sends off spermatic nerves in several branches to pass with the reticular blood-vessels to the testes; it sends one or two branches to ramify and communicate with filaments of the branch of the internal pudendal for supplying the bladder and rectum. In the female, there is a large ganglion in the aortic plexus; this gives branches to a ganglion which sends filaments towards the ovary with the reticular blood-vessels; the aortic plexus then terminates in the large ganglion of the hypogastric, which divides for each side, and sends off the uterine nerves, and also small branches to join those of the internal pudendal for the bladder and vagina. The quantity of nerve proceeding from the internal pudendal for the bladder and rectum, and for the vagina to be joined with that of the hypogastric plexus, is very small; it is however in proportion to the very diminutive bladder and rectum, and must be considered to furnish these as mere receptacles and passages. As there is very little distinction between the upper and lower portions of the intestines, except that they become gradually smaller, so there is no perceptible difference in their nerves; and as there is no need for a capacious cœcum and colon for completing the assimilation of the food, a more simple state of the rectum suffices, and diminutive nerves from the hypogastric and sacral are only required.

In several male animals, the external spermatic nerve communicates with a branch of a lumbar ganglion sent to the aortic plexus, and near this, but not at the precise spot, the internal spermatic nerve arises. The hypogastric plexuses are generally very similar to those in man, but more or less extensive, and combined with a different

proportion of membrane. This plexus may be well seen in a calf a few days old, without any dissection, before the fat has begun to accumulate; and in the baboon, monkey, jaguar, fox, and sow, by just separating the attachments of cellular membrane at the side of the bladder and rectum; its demonstration was also easily made in a very young ass, but in another, presumed to be at least a year old, the dissection was tedious, as the nerves were covered by, and intermixed with, a dense membrane. It is probable that the medullary portions of the nerves of this plexus are intrinsically similar, but that they have a thicker membrane or covering from the surrounding parts, not only in the same animal at different periods of life, but under the particular circumstances to which the organs supplied by them have been subjected. These nerves will therefore be satisfactorily exhibited in some animals rather than in others, or even in man, for when they are imbedded in a thick membrane, they cannot be so easily nor entirely separated. It is necessary, in examinations with the microscope, that this variation should be borne in mind, not only with respect to the nerves of this particular plexus, but to those in other situations.

In the porpoise, the upper portion of the sympathetic, as far as the middle of the thorax, is very much developed, but the lower part is not in the same degree. The thoracic portion has large and fleshy ganglia, probably on account of its supply to the vascular rete, branches from which are sent to mix with and terminate amongst this structure; and it is a most interesting fact, for confirming the opinion entertained of the great influence the sympathetic nerve has in directing the circulation of the blood. It is large in proportion to the spinal cord, and particularly its ganglia in the thorax. The intercostal spinal nerves are the same as in mammalia generally. If the sympathetic arose from the spinal cord, it need not have been enlarged for this change of the bloodvessels, but the spinal nerves would have answered the same purpose.

The sympathetic is often a slender and delicate nerve, therefore its safe position has been carefully chosen. In the neck of man and some animals it is confined to the spine by strong cellular membrane, but in others it is joined with the trunk of the par vagum. In the thorax and abdomen, and pelvis, it is commodiously fixed at the sides of the vertebræ, but more or less inclining towards the middle of the lumbar, according

to the space occupied by the origin of the muscles. It is safely conducted along arteries, as the internal carotid, the vertebral, and several more. It belongs principally to the fifth, sixth, and spinal nerves, but it is also connected with others. It is not combined with sentient nerves only, but motive ones also, as the sixth and the hard portion of the seventh. It is not necessary that it should be joined only with nerves proceeding from a ganglion, for at its very beginning it communicates with the sixth, which has not one. The separation of its own ganglia, and those of the spinal nerves, is not always distinct, as in the thoracic nerves of birds and turtles. The communicating branches are not in proportion to the size of each spinal nerve, but are frequently large, for keeping up a more particular connexion between the internal organs and the external part on which the spinal nerve terminates. Some of the variations of the form and disposition of the prolongation of the sympathetic and the origins of the splanchnic nerves must be attributed to the shapes and motion of the vertebræ, and the convenience of conducting them to the viscera, and not to any required difference in their functions generally. The closer approximation of the prolongation and splanchnic nerves is connected with the form and motion of the vertebræ in animals bending forward at the dorsal, as in the calf, sheep, goat, dog, jaguar, and pig; but the prolongation may be sufficiently secure in man and the baboon, which have a greater power of bending the spine at the lumbar vertebræ, and be more conveniently situated for supplying the viscera, which become so depending in the erect position of the body.

The ganglia of the sympathetic nerve in man, and some animals, consist of a peculiar substance, in which the nerves entering them are entirely lost, and from which others proceed; but as this structure is not absolutely necessary in animals of the same class, it is provided for modifying the functions of the sympathetic, and the organs supplied by it. In whatever part of many animals corresponding portions of the sympathetic nerve be examined, a difference of the structure of the ganglia in each region, and of the disposition of the nerves proceeding from them, will be found, as well as several variations of corresponding ones; it is therefore most probable that each form of ganglion gives its own degree of power, and determines some peculiarity

in every region of the body by modifying the functions of nerves with which it combines.

In the calf, the coarse structure is well calculated for showing the connexions between the sympathetic and spinal nerves. The branches of the sympathetic can be traced close to the anterior and posterior bundles of spinal nerves with which they coalesce, but cannot be followed to the spinal cord without severing communicating filaments. After general and careful observation, it must be determined that branches proceed from the ganglia of the sympathetic to the spinal nerves, and become incorporated with them after separating into minute filaments. The texture of the sympathetic itself is more fibrous, or open, in some parts of different animals, and the ganglion may also appear in threads like a plexus, or be more close and solid, and having a fleshy character. In the ass, the cervical and first thoracic ganglia are close and the spinal open; part of the semilunar is close, but not of so dense a texture as in man. The other thoracic ganglia of the sympathetic, with the prolongation and the first and second lumbar, correspond with the open texture of the ganglia of the dorsal and the first and second lumbar nerves of the spine; the third lumbar ganglion, both of the sympathetic and spinal nerves, is less flat and open; the rest of the lumbar ganglia of each are more close and oval, but still of a loose texture. In the pig, all the ganglia of the spinal nerves are close, but not so large, in proportion to the size of the nerves, as in man; all the ganglia of the sympathetic are close; the semilunar is formed of a delicate plexiform membrane, with some thin patches of close ganglion, and all the plexuses for the abdominal viscera are very slender, until the termination of the aortic in the large ganglion at the beginning of each hypogastric plexus. The spinal and sympathetic ganglia may therefore be placed with those of simiæ, but the semilunar below those of the ass. In the simiæ, hedgehog, jaguar, and dog, the spinal ganglia are close, and each bundle becomes combined in one mass; all the ganglia of the sympathetic are also close and membranous, and not open, as in many of those in the calf and goat, and in a still greater degree in the ass. Some of the ganglia of the sympathetic, which appear close, are not of a solid texture, like those in man, but are formed of a denser congeries of fibres.

In man, a distinct ganglion generally connects the right phrenic nerve and semilunar ganglion, but only very minute filaments, passing on the phrenic artery, the left. A junction has been observed on the right side in a baboon, but not in any other animal: further inquiry is, however, necessary; and although in man filaments from it have been traced to the inferior vena cava, yet the greatest portion joins the left hepatic plexus.

The duodenum, the small intestines and the cœcum, and a more or less extensive portion of the upper part of the colon, are furnished by the superior mesenteric plexus, which has a considerable admixture of branches from the par vagum; in man, the baboon, jaguar, dog, fox, calf, ass, and pig, the remaining portion of the large intestines, as far as the rectum, is supplied by the sympathetic. In man and the baboon, the descending portion of the colon has an extraordinary quantity of nerves from the aortic and hypogastric plexuses. The hypogastric plexuses near the bladder and rectum are joined by branches from the third and fourth sacral nerves in man, and similar ones in animals, and although they do not emerge from the same sacral foramina, a mixed power is produced, which is neither altogether voluntary nor involuntary, yet capable of performing both functions. Thus a gradual change is made in the nerves throughout the alimentary canal; first, in the great supply of cerebral nerves in the stomach and a less one of the sympathetic; next, a diminished quantity of cerebral nerves, and an increased one of the sympathetic; then a supply of the sympathetic only, and afterwards an admixture of this with the spinal nerves, when there is an entire cessation of the proper intestinal secretions and functions; and lastly, the spinal nerves alone, for the sphincter and other muscles of the perineum and the skin. The kidney is furnished by the sympathetic only, the ureter also receives filaments from this as well as from the hypogastric plexus; the bladder, which is only a reservoir, and merely secretes mucus, is supplied by the sympathetic and spinal nerves conjoined; there is nearly the same analogy with respect to the contribution of branches from the sympathetic only for the testes, and the mixed nerves, for their reservoirs, the vesiculæ seminales, and their ducts. It may be further observed that the aortic plexus, by dividing into the two hypogastric to become combined with

branches of the sacral nerves, which are so intimately connected with the internal pudendal, associates the various nerves of the lower portion of the intestines, the kidneys and ovaries, and testes, and the several outlets and parts connected with the completion of their functions. These nerves, as well as the rest of the sacral and caudal, both anteriorly and posteriorly form the most extensive communications in the body, and although the several parts furnished by them are connected together in many functions, they can also be influenced by them separately.

Although the mode of distribution of the sympathetic may be very similar, yet all the ganglia and nerves may be modified by changes of structure for according with the nervous system generally, or particular ganglia may have a more close or open texture for assimilating with the required functions of any of the viscera: therefore by one form throughout it may coincide with all the other nerves, or by a peculiar structure of any of its ganglia be modified to changes in the viscera, and by the varied form of its plexuses, connect together, in a greater or less degree, the organs in each region. Its relation to the sanguiferous system and the great nervous centres deserves especial notice. Its beginning is placed upon the internal carotid artery, branches ascend on the vertebral from the inferior cervical and first thoracic ganglia, others accompany the intercostal and lumbar arteries, and thus the bloodvessels of the brain, and every portion of the spinal cord are brought under the same influence; it also regulates the action of the bloodvessels generally, as well as those supplying the nerves themselves, to some distance at least, probably through the branches, which communicate with all the spinal and some of the cerebral nerves, and thus keeps up a similar degree of circulation between the nerves and their centres, and between them and the organs of the body.

The sympathetic nerve is supplied with blood by very small contiguous arteries, and the vessels of the ganglia are only connected through other slender ones conducted along the prolongation. The circulation in the ganglia is very moderate until they are excited by the commencing activity of the organs on which these nerves are distributed, or are made to partake of the plethora of their contiguous vessels. They chiefly retain the colourless parts of the blood, but become very red from irritating causes, arising in

the system generally from diseases or poisons, or from the particular viscera they supply. They become very much coloured when their vessels are disturbed after a minute injection, but this appearance must not be considered as even in a moderate degree approaching their ordinary condition in the healthy and quiescent state of the organs they animate.

In the human fœtus, the sympathetic as well as the spinal nerves and their ganglia are formed at an early period, and when very little more is apparent than the membranes of the spinal cord. In a human fœtus of about five months old, the superior cervical ganglion was large, and the conjunction of the par vagum and ninth had some similarity to a ganglion. The superior thoracic ganglion was large, but could not be well separated from the inferior cervical; all the other thoracic ganglia were large and well defined, and had a distinct prolongation between them. The origins of the splanchnic nerve were distinct; the splanchnic nerve communicated with the large renal capsule, and passed to the semilunar ganglion, which was very extensive, and appeared to be formed more in globules than in the adult. The communication with the right phrenic nerve was seen, and all the plexuses were distinct on their respective arteries; the spermatic, however, was not satisfactorily traced. The posterior trunk of the par vagum communicated with the cœliac plexus; the hypogastric proceeded to the bladder, and at this part seemed to give filaments about the passage of the umbilical arteries. The spinal cord was nearly perfect, but reached to the bottom of the sacrum, and all the spinal ganglia were large and well formed. In a human fœtus of about four months, the ganglia of the sympathetic throughout the thorax were like patches of white cerebral matter, coalescing with each other, and, from these, branches proceeded to the spinal nerves and the splanchnic. The other ganglia were not satisfactorily observed. The spinal cord, however, was nearly perfect, and its ganglia well formed, and there was a ganglion at the superior part of the par vagum. The renal capsules were very large. In a human fœtus of about three months, the ganglia of the sympathetic were nearly the same as in that of four months, as well as those of the spinal cord, but they were not so large.

PLATE XXVI.

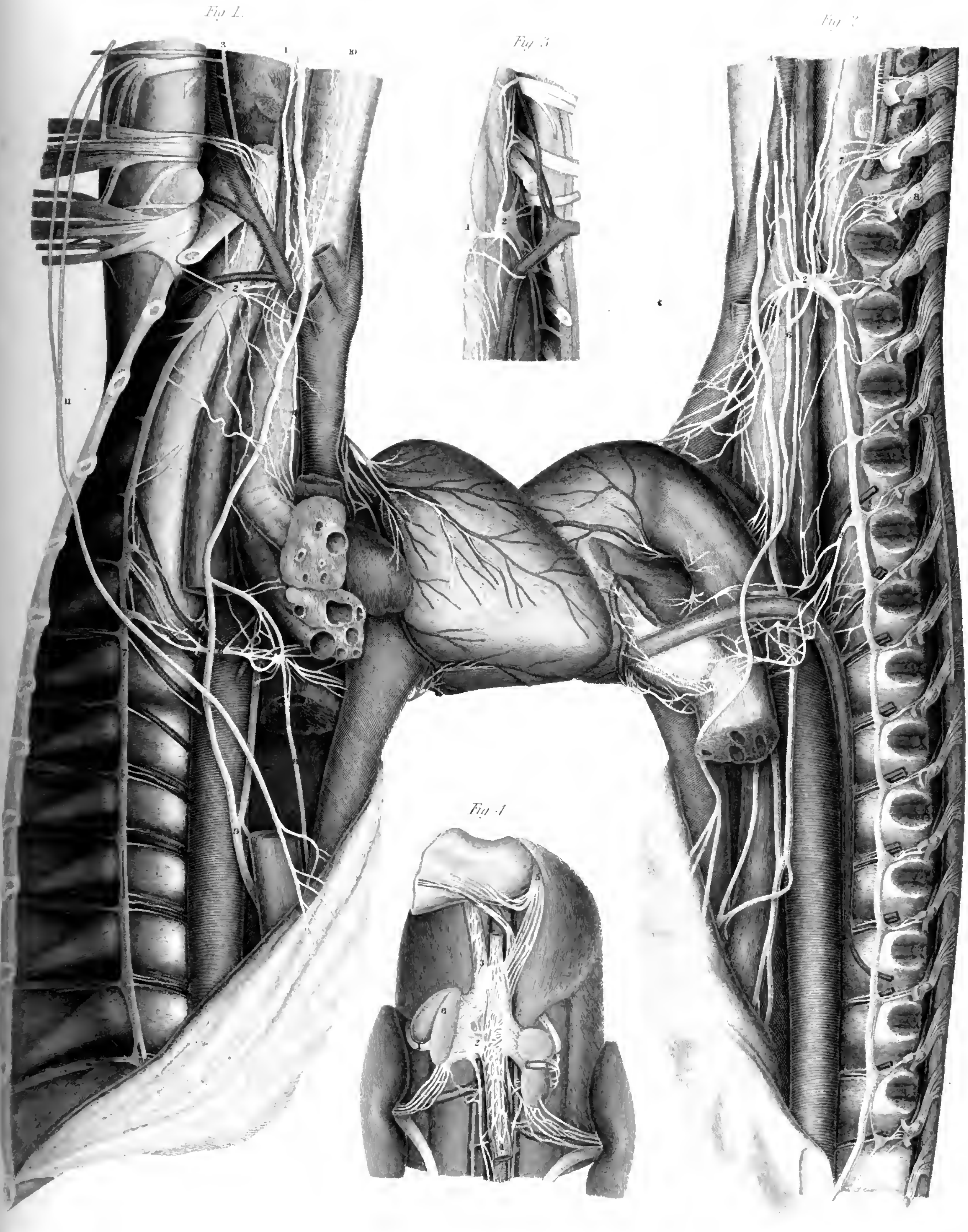
Fig. I.

THE SYMPATHETIC NERVE IN THE RIGHT SIDE OF THE CALF.

(BOS TAURUS.)

In this figure the heart is placed for shewing the right coronary artery.

1. Prolongation of the sympathetic; near the bottom of the neck it separates from the trunk of the par vagum, and sends off a branch to the recurrent nerve; it passes behind the subclavian artery and one sending off the superior intercostal, to the first thoracic ganglion, having previously sent a smaller branch to this ganglion.
2. First thoracic ganglion of the sympathetic nerve.
3. A large branch from the first thoracic ganglion of the sympathetic nerve passing up with the vertebral artery, and communicating with the cervical nerves, and following the artery into the spinal canal.
4. A large branch from the first thoracic ganglion passing behind the innominata, to which it gives filaments, and then behind the ascending aorta and the pulmonary artery, and emerging from beneath this vessel to follow the left coronary artery to the left ventricle of the heart. This termination is seen in Fig. 2.



Drawn by West.

Engraved by Bisden

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5. Branches from the first thoracic ganglion, which communicate with others from the prolongation, and with a branch of the par vagum forming the anterior pulmonary plexus, and then pass behind both auricles, to which they are distributed.

6. Right thoracic plexus: it arises from the third, fourth, and fifth thoracic ganglia; below the root of the lung it communicates with a nerve 8, formed from branches of each trunk of the par vagum, which gives branches to the lungs; it sends some branches behind the inferior vena cava, to give branches to the left auricle and ventricle, and others to communicate with the left thoracic plexus, accompanying the left azygos vein some way in their course towards their termination in the left auricle and ventricle; some of its branches also pass behind the œsophagus to communicate again with the left thoracic plexus.

7. Prolongation appearing flat like tape, and composed of longitudinal threads communicating with each other, and having a slight difference in the form of a ganglion at each spot where branches are given off to the aorta and each intercostal nerve; after the thoracic plexus is given off, it becomes much narrower: it then gradually gets broader after every communication with a spinal nerve, almost as if the branch from each intercostal nerve had been added to it, and as if the splanchnic nerve were joined to it, as it would be in man, if the prolongation and branches forming the splanchnic nerve were drawn together; it is then continued through the diaphragm into the semilunar ganglion, and forms a close connexion with the renal capsule, but just about its termination in this it sends down the prolongation to the lumbar ganglia, which send branches to the abdominal viscera, and communicate with the lumbar and sacral nerves. The branches from the semilunar ganglion are very much like those in man, but not quite so complex.

8. Smaller or anterior branch of the trunk of the par vagum: it is joined by a branch from the left side, to form a small cord; it communicates with the thoracic plexuses, and gives branches to the lungs; it passes anteriorly on the œsophagus, then penetrates the diaphragm and receives a branch from

the junction of the two nerves forming the posterior cord, and gives branches to the second and third stomachs, and a large one to pass over the third to the fourth, and to be continued along the smaller curvature of this and communicate with filaments of another branch passing in the small omentum, and forming the left hepatic plexus; it communicates also with branches of the right hepatic plexus, which proceed from the right semilunar ganglion, and accompany the pyloric artery; branches from the left hepatic plexus, pass first on the duodenum and then towards the other branches of the anterior trunk of the par vagum just described. The trunks of the par vagum give branches to the various stomachs, and their mode of doing it seems to be more for convenience than for any difference there is between the anterior and posterior divisions of these nerves.

9. The continuation of the right trunk of the par vagum becomes joined to an equal portion of the left, and forms the posterior cord; its junction sends a branch to the smaller or anterior branch 8, just when this has passed through the diaphragm; it sends downwards branches, as soon as it has passed through the diaphragm, to the plexus of the semilunar ganglia, surrounding the cardiac and superior mesenteric arteries; a great part of it then terminates principally on the great bag or first stomach, but it sends another large branch, filaments of which also communicate with branches from the semilunar ganglia sent on the arteries of the stomach, and then passes to terminate in the back of the third and fourth stomachs.

10. Recurrent nerve.

11. Phrenic nerve.

FIG. II.

THE SYMPATHETIC NERVE IN THE LEFT SIDE OF THE CALF.

(BOS TAURUS.)

IN this figure the heart is placed for showing the left coronary artery.

1. Prolongation of the sympathetic passing to the first thoracic ganglion; about the middle of the neck a small ganglion appears to be inserted into it whilst it is connected with the par vagum, and from this small ganglion a branch accompanies an artery to the muscles on the outer part of the neck.
2. First thoracic ganglion: many branches are given off from it, which form a plexus, and give filaments to the pulmonary artery and aorta and the right auricle, and then accompany the right coronary artery to terminate on the right ventricle of the heart; the termination is seen in Fig. 1.
3. Left thoracic plexus: it arises from the first, second, third, and fourth thoracic ganglia of the sympathetic; it sends branches some way with the left azygos vein to the left auricle and ventricle, and to communicate with branches from the right thoracic plexus, coming from behind the inferior cava, and others from behind the œsophagus.
4. Trunk of the par vagum.
5. Recurrent nerve.
6. Phrenic nerve.
7. Two large branches from the sixth cervical nerve communicate with a branch from the first thoracic ganglion of the sympathetic, and then pass to be distributed to a muscle on the anterior part of the spine, and the others are connected with the first thoracic ganglion of the sympathetic.

8. Seventh cervical nerve receiving branches from the first thoracic ganglion; the filaments of which, terminating on the spinal nerves, are very minute, and cannot be truly separated from these and traced to the spinal cord; filaments of the branches of the sympathetic proceeding towards the spinal nerves are given to the ligaments and other structures.
9. Spinal nerve, showing how the small branches collected from the spinal cord pass inclosed in separate sheaths of the dura mater; the ganglion is coarse and thready, and is more uneven on its surface, and contains less of the red interstitial matter than in man.

Fig. III.

THE FOX.

(CANIS VULPES.)

1. INFERIOR cervical ganglion of the sympathetic impacted on one side of the trunk of the par vagum.
2. First thoracic ganglion of the sympathetic.

Fig. IV.

THE DOG.

(CANIS FAMILIARIS.)

1. SPLANCHNIC nerve. 2. Semilunar ganglion. 3. Hepatic plexus. 4. Superior mesenteric plexus. 5. Posterior cord of the par vagum. 6. Renal capsule.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

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PLATE XXVII.

Fig. I.

THE CONNEXION BETWEEN THE UTERINE AND MAMMARY NERVES OF THE ASS.

(EQUUS ASINUS.)

1. SPLANCHNIC nerve.
2. Semilunar ganglion.
3. Hepatic plexus.
4. Splenic plexus.
5. Superior mesenteric plexus.
6. Aortic plexus terminating in a ganglion, which gives off the inferior mesenteric plexus, and then divides into the hypogastric.
7. Internal spermatic nerve.
8. External spermatic nerve, arising from the third lumbar nerve, and terminating principally on the mamma.
9. Branches of the posterior trunk of the par vagum passing to the cœliac plexus.

Fig. II.

THE CAUDAL NERVES OF THE CALF.

(BOS TAURUS.)

1. Prolongation of the sympathetic nerve; in descending it is connected with the lumbar, sacral, and caudal ganglia, and, with the prolongation of the left side, forms the single ganglion about the middle of the third caudal vertebra; this ganglion gives off two branches to unite a little lower down into one, and pass with and distribute filaments on the caudal artery.
2. Anterior caudal nerve; it is formed of branches from the anterior trunks of the lower sacral and caudal nerves after they have communicated with the sympathetic; it gives off branches to the muscles and skin in its passage.
3. Posterior caudal nerve; it is formed of the posterior trunks of the lower sacral and caudal nerves, and passes down, giving branches to the muscles and skin.

Fig. III.

THE SPINAL CORD OF THE HEDGEHOG.

(ERINACEUS EUROPÆUS.)

The spinal cord is short and thick, and terminates in a point about the sixth dorsal vertebra.

FIG. IV.

THE SPINAL CORD OF THE BABOON.

(SIMIA PAPIO.)

THE thick portion of the spinal cord extends to the bottom of the second lumbar vertebra; the point reaches to the lower part of the fourth. Many of the ganglia are placed within the spinal canal.

FIG. V.

THE SPINAL CORD OF THE DOG.

(CANIS FAMILIARIS.)

THE thick portion of the spinal cord reaches to about the bottom of the sixth lumbar vertebra; its point terminates in the canal of the sacrum.

The figure of the hedgehog is the exact size of the preparation from which it is taken; that of the baboon and dog have been reduced to the length of that of the hedgehog from very accurate drawings of the parts of their natural dimensions; and thus the difference of the termination of the spinal cord and the length and breadth of the cauda equina may be accurately observed.

PLATE XXVIII.

FIG. I.

THE SYMPATHETIC NERVE OF THE LEFT SIDE OF A BABOON.

(SIMIA PAPIO.)

a. STOMACH. *b.* Liver. *c.* Spleen. *d.* Pancreas. *e.* Termination of the ilium in the colon.

1. Prolongation of the sympathetic.
2. Great splanchnic nerve; its origin extends over the heads of five ribs; it forms a ganglion with the prolongation before it passes through the diaphragm.
3. Semilunar ganglion.
4. Prolongation of the sympathetic of each side joining on the caudal artery.
5. Cœliac plexus.
6. Right hepatic plexus.
7. Superior mesenteric plexus.
8. Inferior mesenteric plexus.
9. Internal spermatic plexus.
10. Hypogastric plexus joining branches of the sacral nerves for the bladder and rectum.
11. Posterior trunk of the par vagum giving branches to the stomach, and then joining the cœliac plexus.

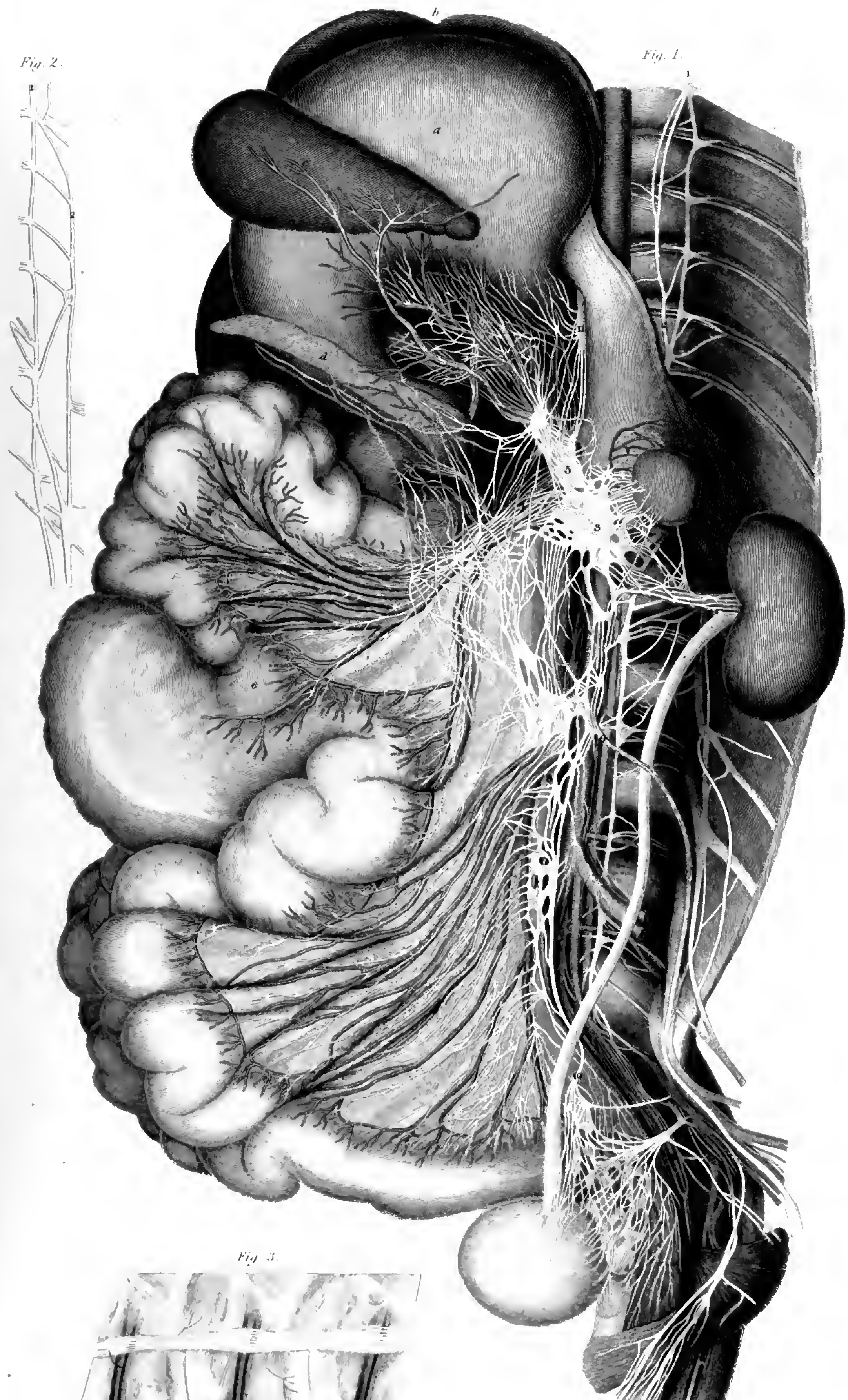

Fig. 2.

Fig. 1.

Fig. 3.

awn by West.

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Fig. II.

(THE SAME.)

1. Prolongation of the sympathetic of the right side.
2. Splanchnic nerve; its origin extends over the heads of seven ribs; it expands into a ganglion, which is not however joined with the prolongation as on the left side.

Fig. III.

THE ASS.

(EQUUS ASINUS.)

The appearance of the thoracic portion of the prolongation of the sympathetic nerve before it has been disturbed.

PLATE XXIX.

Fig. I.

THE FOX.

(CANIS VULPES.)

It shows the vertex of the brain and cerebellum, and the great breadth but small number of the convolutions of the brain.

Fig. II.

THE DOG.

(CANIS FAMILIARIS.)

It shows the vertex of the brain and cerebellum, and its different appearance from that of the fox.

Fig. IX.

THE DOMESTIC CAT.

(FELIS CATUS.)

The brain has been divided through the great commissure, and the superior part of each hemisphere everted.

1. Striated body. 2. Thalamus. 3. Geniculate body. 4. Nates. 5. Testis. 6. Vermiform process of the cerebellum. 7. Lateral lobe of the cerebellum.

Fig. X.

THE HORSE.

(EQUUS CABALLUS.)

It shows the striated bodies, thalami, third ventricle, quadrigeminal bodies, and fourth ventricle.

1. Striated body. 2. Thalamus. 3. Geniculate body. 4. Nates. 5. Testis. 6. Superior pedicle of the cerebellum. 7. Inferior pedicle or crus of the cerebellum. 8. Posterior pedicle of the cerebellum. 9. Third ventricle. 10. Fourth ventricle. 11. Fourth nerve. 12. Fifth nerve. 13. Auditory nerve.

FIG. XI.

(THE SAME.)

1. CRUS of the brain of the left side, which is perfect.
2. Crus of the brain of the right side divided and turned up.
3. Involuntary centre placed between the posterior layer of the annular tubercle and the ventricular cord, forming the floor of the fourth ventricle.
4. Posterior layer of the annular tubercle, passing through the crus of the brain.
5. Optic tract turned up.
6. Nates.
7. Annular tubercle divided.
8. Trapezoid body.
9. Outer layer of the left pyramidal body.
10. A more inner layer of the left pyramidal body, crossing to the right.
11. Origin of part of the larger portion of the fifth nerve from the involuntary centre.
12. Auditory nerve connected with the external portion of the restiform body.
13. Hard portion of the seventh nerve proceeding from the trapezoid body.

Fig. XII.

OBLONG MEDULLA.

(HUMAN.)

It shows the oblique or most posterior layer of the annular tubercle extending superiorly through the crus of the brain to the larger portion of the intermediate layer of the exterior region; it gives origin to the smaller portion of the fifth, the hard portion of the seventh, and the ninth nerve.

1. Pyramidal body cut short.
2. Oblique layer of the annular tubercle passing through the crus of the brain.
3. Quadrigeminal bodies.

Fig. XIII.

(THE SAME.)

It affords an opposite view of the same preparation.

1. Median edge of the oblique or posterior layer of the annular tubercle.
2. Involuntary centre placed between the posterior layer of the annular tubercle and the ventricular cord forming the floor of the fourth ventricle.

PLATE XXX.

Fig. I.

THE DOG.

(CANIS FAMILIARIS.)

1. Third nerve, giving branches to the muscles of the eye it usually supplies, and to the lenticular ganglion. The fourth nerve and the superior oblique muscle have been cut short.
2. Sixth nerve.
3. First trunk of the fifth.
4. Second trunk of the fifth.
5. A branch from the second trunk of the fifth, dividing into the palatine and lateral nasal nerves.
6. Malar nerve from the second trunk of the fifth, dividing into the temporal and malar.
7. Third trunk of the fifth.
8. Buccal nerve.
9. Anterior aural, or superficial temporal nerve.
10. Deep temporal nerve.
11. Gustatory nerve cut short, but the branch, passing forward to supply the lining membrane of the mouth, has been preserved.
12. Cord of the tympanum.

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13. Inferior dental nerve.

14. Mylo-hyoideal nerve, arising from the inferior dental; it supplies the lower belly of the digastric muscle, the mylo-hyoideal, and the cutaneous muscle, and sends two branches into the face, to join branches of the hard portion.

15. Two branches of the mylo-hyoideal nerve to join the hard portion in the face.

16. Ganglion of the par vagum.

17. Accessory nerve.

18. Superior cervical ganglion of the sympathetic nerve.

Fig. II.

(THE SAME.)

1. Hard portion of the seventh.

2. A branch of the hard portion for the superior belly of the digastric muscle and the stylo-hyoideal.

3. A branch of the hard portion, piercing the cartilage of the concha, and terminating on the skin lining this.

4. A branch of the hard portion given to the muscles of the external ear; it is joined by the superficial temporal, or auricular branch of the third trunk of the fifth: these, after approaching each other, form a very slight communication, and separate again to be distributed on the muscles and skin of the external ear.

5. Temporal branch of the hard portion continued over the eyebrow to the cutaneous muscle of the forehead and nose, and the orbicular muscle of the eyelids; it communicates with the superficial temporal of the third trunk of the fifth, with the temporal and malar branches of the malar nerve, and the supra-orbital.

6. Middle branch of the hard portion, passing towards the upper jaw, and com-

municating with the buccal and the second trunk of the fifth, and giving branches to the muscles of the face.

7. Inferior branch of the hard portion, communicating with the buccal and the mylo-hyoideal nerve of the inferior dental, then passing towards the chin, communicating with the inferior maxillary nerve after this has emerged from its foramen, and giving branches to the muscles of the face and lower lip. Branches pass backwards from this, and the preceding branch 6, to communicate with others from the first cervical nerve distributed on the cutaneous muscle.

8. Supra-orbital nerve giving branches to the upper eyelid and the integuments of the forehead. Another branch is given off by the first trunk of the fifth, which communicates with the temporal branch of the malar, and is then given to the lachrymal gland, the conjunctive membrane, and the outer portion of the upper eyelid.

9. Temporal branch of the malar proceeding from the second trunk of the fifth; it gives a branch to communicate with one of the first trunk of the fifth for the lachrymal gland, and then passes out at the exterior part of the orbit, communicates with a branch of the hard portion, and is distributed on the cutaneous muscle and skin of the temple.

10. Malar branch of the malar nerve arising with the temporal; it communicates with a branch of the hard portion, and is then given to the skin of the face and the lower eyelid.

11. Continuation of the second trunk of the fifth to terminate on the upper lip and nostril; this and all the other branches of the fifth in the face, communicate freely with the hard portion.

12. Auricular or superficial temporal branch of the third trunk of the fifth, giving branches to the skin of the ear and sending small branches forward to the skin and cutaneous muscle of the face.

13. Buccal nerve of the third trunk of the fifth, communicating with branches of the hard portion, and terminating on the buccinator muscle and skin of the face.

14. Continuation of the inferior dental nerve to the skin and muscles of the lower lip.

15. Two branches of the mylo-hyoideal nerve from the inferior dental, and joining branches of the hard portion 7.

16. A branch of the anterior trunk of the first cervical nerve given to the cutaneous muscle of the neck and the skin of the external ear, and communicating with branches of the hard portion.

17. Branches of the posterior trunk of the first cervical nerve; it gives branches to the cutaneous muscle of the occiput, and of the posterior part of the external ear, and to the skin.

Fig. III.

THE CALF.

(BOS TAURUS.)

1. Hard portion of the seventh.

2. Supra-orbital nerve; it arises with the superior nasal.

3. Nerve terminating on the outer part of the upper eyelid and eyebrow, after it has supplied the lachrymal gland; it arises from the Gasserian ganglion close to and communicating with the temporal.

4. Second trunk of the fifth.

5. Malar nerve, arising from the Gasserian ganglion, and terminating on the lower eyelid.

6. Temporal branch of malar arising from the Gasserian ganglion: it gives branches to the superficial muscle and skin of the temple, the greatest part of it then passes outwards to be distributed on the horn.

7. Auricular branch of the superficial temporal nerve; the anterior branch of this nerve is seen passing forwards to join the middle branch of the hard portion.
8. Continuation of the inferior dental nerve.
9. Gustatory nerve.
10. Buccal nerve.

Fig 1.

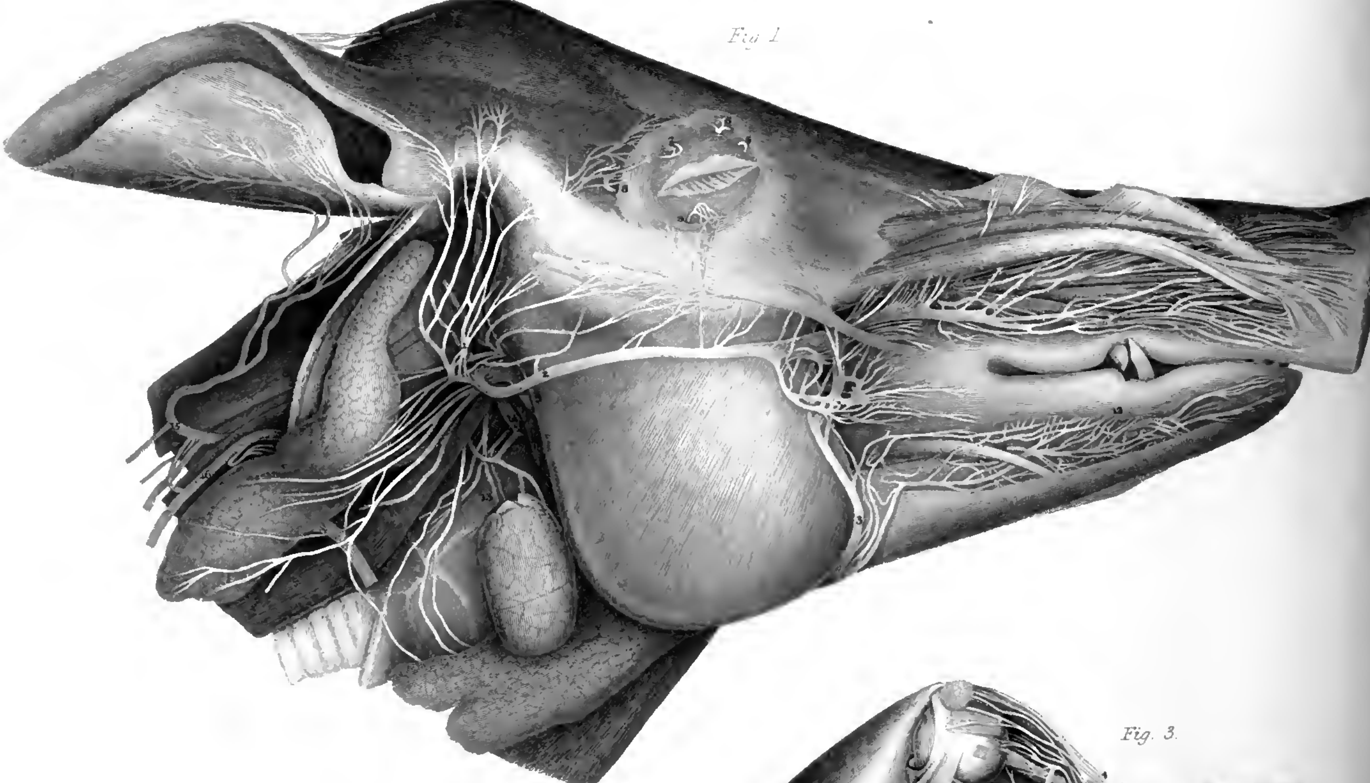

Fig. 2

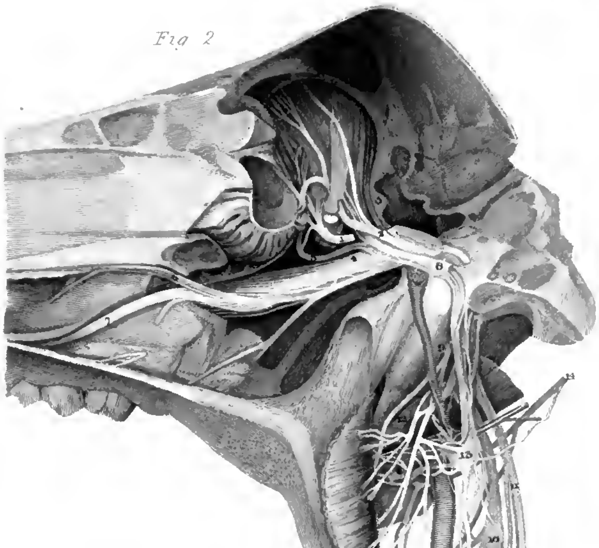

Fig. 3.

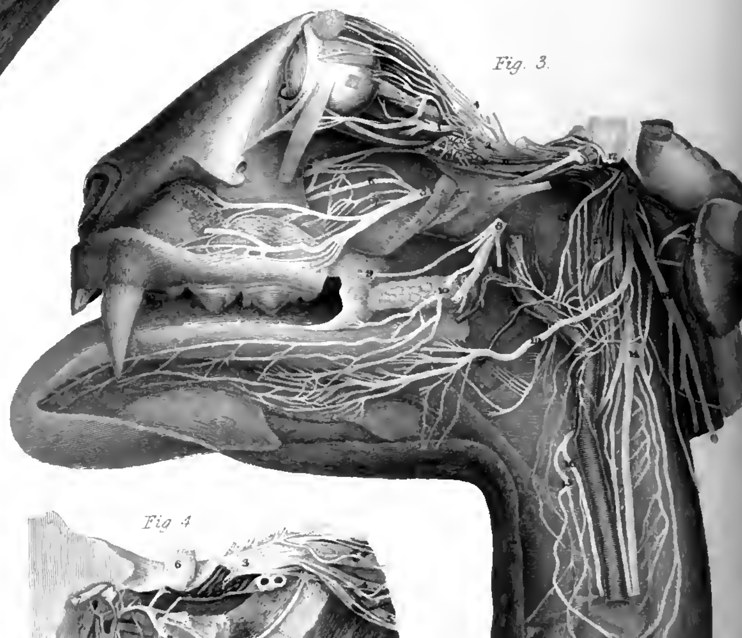

Fig. 4

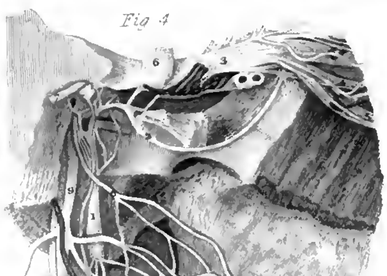

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PLATE XXXI.

Fig. I.

THE FACIAL NERVES OF THE SOW.

(SUS SCROFA.)

1. Temporal branches of the hard portion.
2. Middle branch of the hard portion.
3. Inferior branch of the hard portion; it is seen emerging from behind the angle of the jaw.
4. A large branch of the hard portion for the muscles of the external ear.
5. Continuation of a branch of the superior nasal nerve.
6. Supra-orbital nerve.
7. Continuation of the lachrymal nerve.
8. Temporal branch of the malar nerve.
9. Malar branch of the malar, both the temporal and malar branches arise separately from the second trunk of the fifth.
10. Continuation of the superior maxillary nerve.
11. Buccal nerve.
12. Termination of the inferior dental, several smaller branches are seen coming out more posteriorly at different foramina.
13. Superior laryngeal nerve; it gives a branch to the pharynx and the crico-thy-

roideal muscle, and terminates on the membrane of the glottis, epiglottis, and the superior part of the larynx; it communicates with the recurrent nerve by a finer and a larger branch; the finer communicates with the branches of the recurrent passing to the posterior crico-arytenoid muscle; the larger joins a branch of the recurrent, and forms a broad and thick expansion not much unlike a ganglion, which terminates in branches on the lateral crico-arytenoid and the thyro-arytenoid muscles; the rest of the recurrent gives filaments to the posterior crico-arytenoid, and sends a branch behind this muscle to terminate in the transverse and oblique arytenoid muscles. On the left side the nerves were much smaller.

14. Ninth nerve sending a branch to join one of those proceeding from the sub-occipital to the sterno-hyoid and sterno-thyroid muscles.
15. A branch of the first cervical nerve to the skin of the ear.
16. Accessory nerve.

Fig. II.

THE CONNEXION OF THE CEREBRAL NERVES WITH THE SYMPATHETIC OF THE SAME.

The head was divided perpendicularly at the median line.

1. Third nerve.
2. First trunk of the fifth.
3. A nerve proceeding from one branch of the first trunk placed behind the sixth, the other from the beginning of the second trunk in a spot at which a branch of the sympathetic is received; it is then joined by a branch from the third, and passes to the inferior oblique muscle of the eye.
4. Second trunk of the fifth.
5. Malar and temporal branches arising separately from the second trunk of the fifth.

6. Lateral nasal nerve.
7. Largest of the palatine nerves.
8. Sixth nerve.
9. Glosso-pharyngeal nerve.
10. Ganglion of the par vagum, sending off the superior laryngeal nerve.
11. Accessory nerve.
12. Ninth nerve.
13. First cervical ganglion of the sympathetic, sending branches upwards to the second trunk of the fifth and sixth; there is not a distinct Vidian nerve passing in a canal of bone, but the branch most resembling it may be traced on the second trunk of the fifth to the place from which the lateral nasal and palatine nerves arise; branches also proceed from the ganglion to communicate with the ninth and suboccipital and the pharyngeal plexus, and pass on the carotid artery to the salivary glands and other parts receiving the arterial branches.
14. Anterior trunk of the suboccipital nerve receiving the descending branch of the ninth.

FIG. III.

THE CEREBRAL NERVES OF THE JAGUAR.

(FELIS ONÇA.)

1. THIRD nerve giving branches to the muscles of the eye, and forming the lenticular ganglion on the branch passing to the inferior oblique muscle; the lenticular ganglion sends a ciliary branch on the outer side of the optic nerve to the interior of the eye, and another to the inner side of the optic nerve, to join the branch of the superior nasal nerve, but not to form a ganglion; and from this junction other ciliary nerves pass to the interior of the eye.

2. First trunk of the fifth; the supra-orbital is cut short; the superior nasal is seen sending a branch to join the one from the lenticular ganglion to form ciliary nerves and then pass forward to send one branch into the nose, and another to terminate on the skin at the inner angle of the eye.
3. Second trunk of the fifth divided.
4. Malar nerve arising from the second trunk of the fifth, which has been divided.
5. Lateral nasal nerve receiving the Vidian.
6. Palatine nerve.
7. First superior dental nerve; the next is much larger; filaments of both pass through perforations in the superior maxillary bone to the double teeth, the rest of the large branch then supplies the large pointed tooth, passes round the fang of this and descends to the fang of the first incisor, and winds round this to supply the other two.
8. Third trunk of the fifth divided.
9. Buccal nerve; the deep and superficial temporal are cut short.
10. Gustatory nerve, the inferior dental has been cut short; it gives a branch to the lining membrane of the mouth, and then passes forwards dividing into branches, which communicate with the ninth in their course to the surface of the tongue.
11. Sixth nerve.
12. Hard portion of the seventh.
13. Glosso-pharyngeal nerve.
14. Ganglion of the par vagum.
15. External laryngeal nerve; it sends a long branch downwards, which gives filaments to the pharynx and œsophagus, and communicates with the recurrent at the side of the trachea; this on the left side is given off by the superior laryngeal; it then communicates with a branch from the superior laryngeal; it gives a branch to the crico-thyroid muscle, and sends another through a foramen in the thyroid cartilage to join the superior laryngeal descending behind the wing of the thyroid cartilage.

16. Superior laryngeal nerve; it passes through a foramen in the thyroid cartilage and receives the preceding branch of the external laryngeal, which has passed through another foramen in the cartilage; it sends a branch downwards to join the branch of the recurrent terminating on the lateral crico-arytenoid and the thyro-arytenoid muscles, and is then distributed on the membrane of the glottis, epiglottis, and superior part of the larynx.

17. Recurrent nerve; on passing behind the wing of the thyroid cartilage, besides the preceding communications with the superior and external laryngeal nerves, it sends the branch to the lateral crico-arytenoid muscle, and the thyro-arytenoid; it gives filaments to the posterior crico-arytenoid muscle, and sends a branch behind this muscle to the transverse and oblique arytenoid muscles.

18. Accessory nerve.

19. Ninth nerve, sending off several descending branches before it passes to the muscles of the tongue.

20. Anterior trunk of the suboccipital nerve; it supplies the anterior straight and lateral muscles of the head, and after receiving a descending branch of the ninth it terminates on the sterno-hyoid and sterno-thyroid muscles.

21. Superior cervical ganglion of the sympathetic nerve.

Fig. IV.

THE SYMPATHETIC NERVE OF THE SHEEP.

(OVIS ARIES.)

1. Superior cervical ganglion of the sympathetic nerve. 2. Vidian nerve. 3. Second trunk of the fifth. 4. Lateral nasal nerve. 5. Palatine nerve. 6. Third trunk of the fifth. 7. Hard portion of the seventh. 8. Glosso-pharyngeal nerve. 9. Par vagum. 10. Ninth nerve.

PLATE XXXII.

Fig. I.

THE OLFACTORY NERVE OF THE HORSE.

(EQUUS CABALLUS.)

After the nerve has passed through the cribriform plate of the ethmoid bone, and many of the branches have been distributed on the convoluted plates of this, they are again concentrated a little lower down and coalesce with the lateral nasal nerve, and then give off branches to the Schneiderian membrane covering the turbinated bones and the outer boundary of the nose, whilst others pass to the membrane covering the septum.

1. Bulb of the olfactory nerve.
2. Superior nasal nerve of the first trunk of the fifth.
3. Lateral nasal nerve of the second trunk of the fifth.

Fig. 1.

Fig. 2.

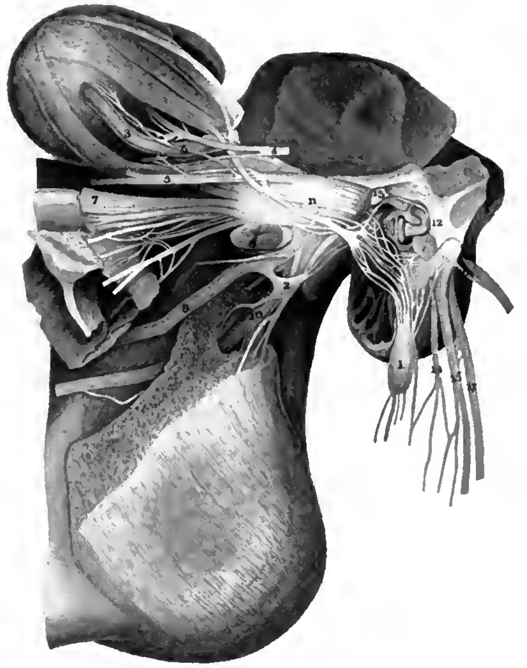

Fig. 3.

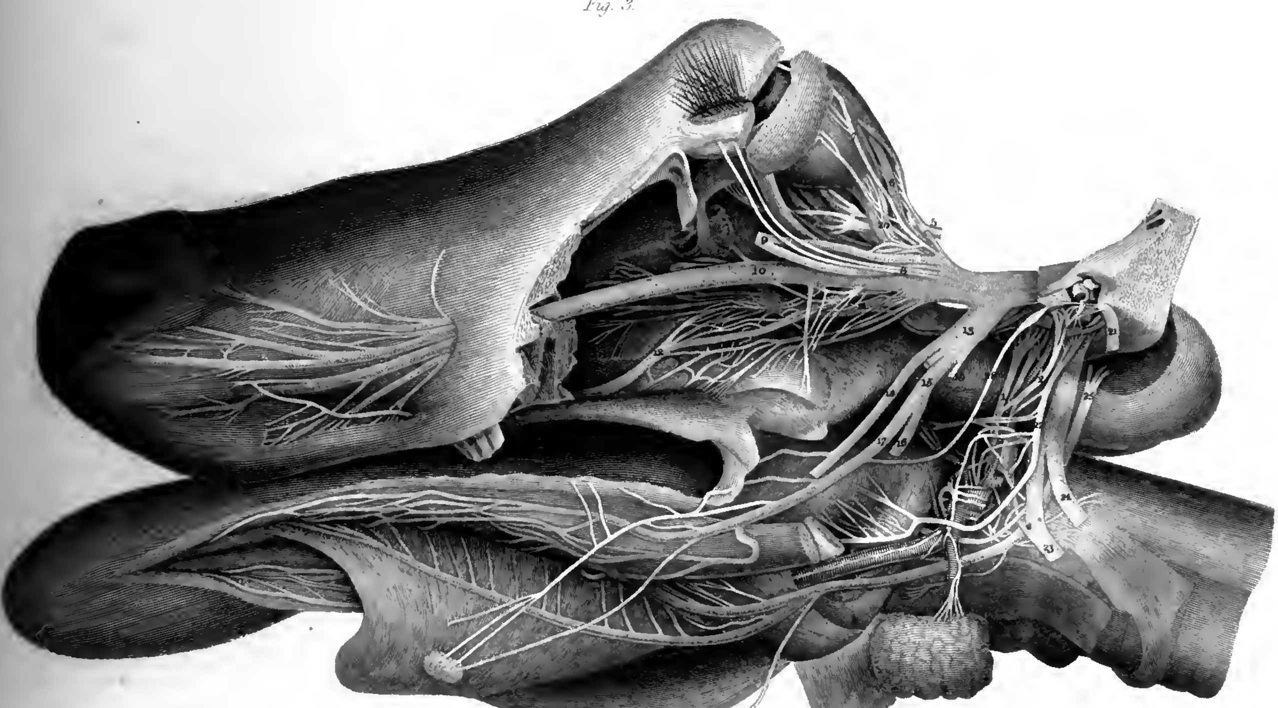

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Fig. II.

THE SYMPATHETIC AND OTHER NERVES IN THE HEAD OF THE CALF.

(BOS TAURUS.)

The head was divided perpendicularly for showing the nerves from the median plane.

1. Superior cervical ganglion of the sympathetic sending branches upwards to the Gasserian ganglion, and others to the surface of the tympanum; it sends also filaments backwards towards the par vagum, the glosso-pharyngeal and ninth, just at their exit from the cranium.
2. Otic ganglion communicating with the buccal nerve, and the trunk giving off the gustatory and inferior dental nerves, and sending branches to the internal pterygoid muscle, and a branch along the Eustachian tube, where it divides into two, one of which joins the branches of the sympathetic in the tympanum, and the other terminates on the tympanum.
3. Optic nerve.
4. Third nerve.
5. First trunk of the fifth.
6. A branch arising from the Gasserian ganglion, near the first trunk of the fifth, at the part receiving branches from the superior cervical ganglion of the sympathetic; it passes into the orbit, and receives a branch from the third nerve to form the ciliary ganglion, from which the ciliary nerves are sent along the optic nerve into the eye.
7. Second trunk of the fifth.

8. Deep temporal nerve of the third trunk of the fifth, sending a branch to the temporal muscle, and then terminating in the masseter.
9. Buccal branch of the third trunk.
10. Large branch of the third trunk, giving off the inferior dental and gustatory nerves.
11. Sixth nerve.
12. Auditory nerve, giving one portion to the cochlea, and the rest to the vestibule and semicircular canals.
13. Hard portion of the seventh communicating with the vestibular part of the auditory nerve, and the sympathetic, and with the trunk of the par vagum, and then passing forward to supply the muscles of the external ear, and those of the face and lips, and communicate with branches of the fifth, and the superior cervical nerves.
14. Glosso-pharyngeal nerve.
15. Trunk of the par vagum.
16. A branch from the trunk of the par vagum, to join the hard portion of the seventh.
17. Accessory nerve.

Fig. III.

(THE SAME.)

It shows the nerves from the exterior surface, after the removal of the lower jaw and part of the cranium.

1. Branches from the superior cervical ganglion of the sympathetic, sending branches upwards to communicate with the Gasserian ganglion, and more particularly with the part giving off the second trunk, also with the sixth.
2. A branch of the sympathetic passing upwards, and sending filaments into the

tympanum to communicate with the tympanine nerve of the glosso-pharyngeal, and the cord of the tympanum on the outer surface of the labyrinth; then, like the Vidian nerve, passing forwards in a canal to join the nasal branch of the second trunk of the fifth, and assume a ganglionic appearance.

3. A branch of the superior cervical ganglion of the sympathetic, which joins branches of the glosso-pharyngeal and the trunk of the par vagum; branches are then given to the pharynx, whilst others accompany the divisions of the carotid artery to the salivary glands, and other parts on which these vessels are distributed.

4. Prolongation of the sympathetic passing to the trunk of the par vagum; it passes near to the bottom of the neck, connected with this by loose neurilema, and also by several nervous filaments.

5. Third nerve; it supplies all the muscles of the eye, except the superior oblique, the abducent, and the retractor; it communicates with a branch from the fifth in the ciliary ganglion, which sends branches along the optic nerve, and through the sclerotic coat into the eye to the choroid coat and iris; these branches are fewer and thicker than in man.

6. First trunk of the fifth, dividing into the supra-orbital and superior nasal; the supra-orbital passes out at the upper part of the orbit to the upper eyelid and integuments of the forehead; the superior nasal enters a foramen at the inner side of the orbit to pass to the cribriform plate of the ethmoid bone, then passes through one of the perforations into the nose, and divides into two branches, one of which is continued on the Schneiderian membrane at the superior part of the septum, and the other on that covering the superior turbinated bone; both give branches to the membrane near the anterior extremity of the nose, which part is supplied by branches of the second trunk of the fifth, passing into the nose just above the nostril.

7. Lachrymal nerve arising from the Gasserian ganglion with the nerve 9; it gives branches to the lachrymal gland, and sends one forward to the upper eyelid.

8. Two branches from the Gasserian ganglion, passing to the lower eyelid, and resembling the malar portion of the malar nerve.

9. A nerve corresponding with the temporal portion of the malar; it passes out at

the exterior of the orbit, and gives branches to the superficial muscles and integuments on the temple; the greatest part of it is then distributed on the horn. Two other branches from the Gasserian ganglion pass outwardly in a canal on the inner plate of the frontal sinus to the junction of this with the outer plate, and near the insertion of the horn.

10. Second trunk of the fifth, passing out at the infra-orbital foramen to divide into branches, to be distributed on the upper lip, the outer side of the nose, and the Schneiderian membrane at the inferior part of the nose.

11. Lateral nasal nerve of the second trunk of the fifth, receiving the Vidian nerve, and passing into the nose to the Schneiderian membrane.

12. Palatine branch of the second trunk of the fifth, communicating with the lateral nasal, and terminating on the palate.

13. Third trunk of the fifth.

14. Buccal nerve from the third trunk of the fifth; it gives a branch to the external pterygoid muscle; it then passes over the inner surface of this muscle; it emerges from underneath the anterior edge of the masseter, and divides into branches, which terminate on the buccinator muscle and skin of the face; it forms considerable communications with branches of the hard portion of the seventh.

15. A branch dividing into the inferior dental and gustatory nerves; branches are also given to the circumflex muscle of the palate, and the internal pterygoid muscle.

16. Inferior dental nerve; it sends off close to the jaw the mylo-hyoideal nerve, which passes down to supply the mylo-hyoideal muscle, and the maxillary portion of the digastric; it then enters the jaw, supplies the teeth, and emerges near the chin to divide into branches, communicate with branches of the hard portion of the seventh, and terminate in the lower lip.

17. Gustatory nerve; it receives the cord of the tympanum; it passes forward and divides into branches, which ascend to the anterior portion of the surface of the tongue, between the insertions of the genio-hyo-glossal and lingual muscles; it gives branches also to the salivary glands, and the membrane of the mouth connecting the lower jaw and side of the tongue.

18. Cord of the tympanum communicating with the hard portion of the seventh, and in the tympanum with the tympanine nerve of the glosso-pharyngeal and the sympathetic, and passing forward to join the gustatory nerve.

19. External auricular, or superficial temporal nerve, proceeding from the third trunk of the fifth; it passes behind the ramus of the jaw; it sends a large branch forward to join the middle branch of the hard portion of the seventh; it sends a large branch backwards, one part of this passes to the inner surface of the concha of the ear, the other communicates with a branch of the hard portion of the seventh, passing to the muscles of the external ear, and then terminates on the skin near the margin of the concha.

20. Sixth nerve; it communicates with the sympathetic, and a branch of the fifth passing to the lenticular ganglion; it terminates in the abducent and retractor muscles.

21. Hard portion of the seventh.

22. Glosso-pharyngeal nerve; it sends filaments into the tympanum to communicate with branches from the sympathetic and the cord of the tympanum; it gives branches to communicate with branches of the sympathetic and the par vagum; it gives branches to the muscles of the pharynx and the divisions of the carotid artery, and then passes forwards, distributing branches to the tonsils, the posterior part of the tongue and the membrane continued towards the larynx.

23. Trunk of the par vagum; it communicates with the hard portion of the seventh, and, soon after it has emerged from the skull, with the accessory nerve; it gives off a branch to join others from the glosso-pharyngeal, to be distributed on the pharynx; next it communicates with the first cervical ganglion of the sympathetic; it then gives off the superior laryngeal nerve to the larynx, and passes down the neck.

24. Accessory nerve; it is joined by branches of the superior cervical nerves, and is then distributed on the sterno-mastoid and trapezius muscles.

25. Ninth nerve; it sends a filament to join the anterior trunk of the suboccipital, which gives branches to the sterno-hyoideal and sterno-thyroideal muscles, and then divides into branches for the muscles connected with the hyoid bone and the tongue.

PLATE XXXIII.

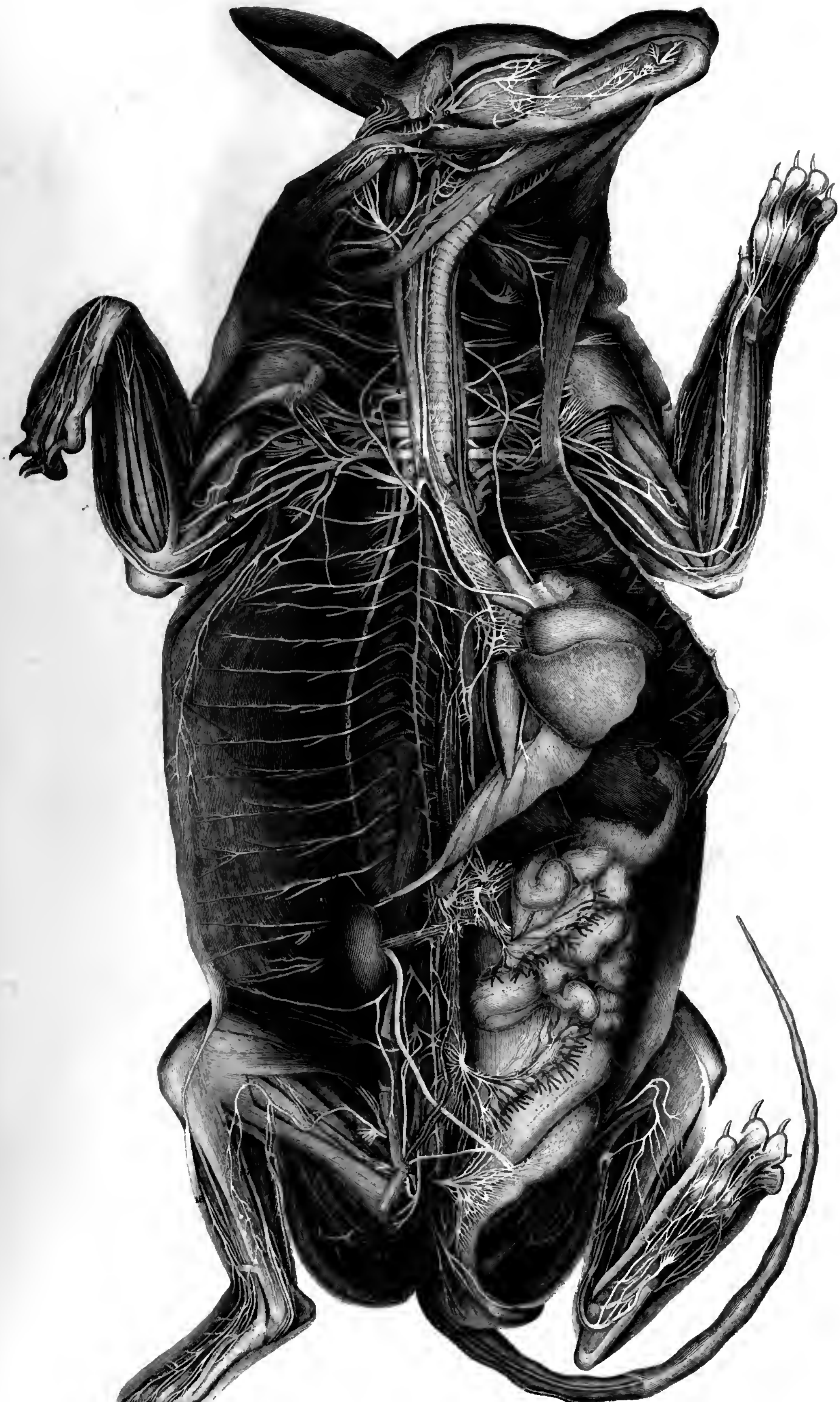
THE FOX.

(CANIS VULPES.)

1. Suboccipital nerve; it emerges from a foramen in the atlas; the anterior trunk passes forwards, and sends up two filaments to the junction of the trunk of the par vagum with the glosso-pharyngeal, the ninth, accessory, and the superior cervical ganglion of the sympathetic; it gives branches to the anterior straight muscles of the head, and then joins the slender descending branch of the ninth, to be distributed on the sterno-hyoid and thyroid muscles; the posterior trunk terminates on the posterior straight and oblique muscles.

2. First cervical nerve; the anterior trunks of the first and second cervical nerves give branches to the anterior straight muscles of the head, and then unite to communicate with the accessory, and divide into branches, which are distributed on the cutaneous muscle and skin, at the side of the face and neck and external ear. The third gives a branch to join the accessory and others to the trapezius muscle, and is then distributed on the cutaneous muscle and skin at the side of the neck. The fourth gives a branch to the accessory, and to the trapezius muscle, and then pierces this to terminate on the skin at the lowest part of the neck. The posterior trunk of the first cervical nerve gives branches to the splenius, complex, and other muscles, close to the posterior part of the spine, and then sends a branch through the complex towards the occiput, which gives filaments to the muscles inserted into the

PLATE XXXIX



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back of the ear, but is chiefly distributed on the skin of this part. The posterior trunk of the second, after giving branches to the splenius, complex, and other muscles, close to the posterior part of the spine, also sends a branch through the complex muscle to the skin of the occiput. The posterior trunk of the third gives branches to the complex and other muscles close to the spine, and then terminates on the skin. The posterior trunks of the fifth and sixth also give branches to the muscles and skin; the seventh was traced to the muscles only; the three last are much smaller than the preceding.

3. Phrenic nerve; it is formed of a branch from the fourth and fifth cervical nerves; it passes over the pericardium to the diaphragm, and on the right side is placed close to the inferior vena cava.

4. Fifth cervical nerve; the axillary plexus is constituted of the three inferior cervical and the first dorsal nerves, but the greatest part of the fifth, after receiving a branch from the sixth, gives a large branch to the integuments on the anterior part of the shoulder joint, and then passes to form the superior scapular nerve, and terminate on the superior and inferior spinous muscles. Branches from the fifth, sixth, and seventh cervical, and first dorsal, are given to the pectoral muscles; a branch from the sixth cervical is given to the great serrated muscle, and branches from the fifth and sixth to the subscapular.

5. A branch from the seventh cervical nerve, passing down the side of the cutaneous muscle and skin, and communicating with the external branches of several of the dorsal nerves.

6. Circumflex nerve; it arises from the union of the fifth and sixth cervical nerves; it gives branches to the subscapular and teres muscles, and then divides and sends a branch to the inferior spinous muscle and the deltoid, and branches to the integuments on the outer side of the arm.

7. Internal cutaneous nerve; it is a slender nerve sent off by the ulnar; it passes down the arm, and, near the inner condyle of the humerus, divides into branches to be distributed on the skin at the ulnar side of the fore-arm. The smaller internal cutaneous nerve is the external branch of the second dorsal

after its egress from between the ribs; it pierces the broadest muscle of the back, and divides into branches to be distributed on the skin at the inner and posterior part of the arm.

8. Musculo-cutaneous nerve; it arises from the sixth cervical along with the outer portion of the median; it gives a branch to the pectoral muscle and the coraco-brachial, and then passes off to terminate on the biceps.

9. Median nerve; the sixth cervical having given off the nerve analogous to the usual musculo-cutaneous, the remaining part gives off a branch, which sends one back to the internal brachial muscle behind the tendon of the biceps, and then gives branches to the skin of the fore-arm, in the place of the cutaneous portion of the musculo-cutaneous in man; it then joins the branch from the seventh cervical and first dorsal nerves, about an inch above the elbow, to form the median nerve, which is small as compared with that in man; the nerve thus formed passes under the origin of the round pronator muscle, and gives branches to this, the radial flexor muscle of the wrist, and the sublime and deep flexors of the fingers; it then passes by the side of the radial flexor and between the sublime and deep flexors underneath the annular ligament; it is continued in the hand between the tendons of these muscles, at the division of which it sends off branches; it gives filaments to the skin of the palm, and a branch to the short prominence corresponding with the thumb, and the inner side of the first finger, and a branch to be joined by one from the deep palmar for the outer side of the first finger and the inner side of the second; another branch also to be joined by a branch from the deep palmar for the outer side of the second and the inner side of the third.

10. Ulnar nerve; it is formed from the seventh cervical and first dorsal, as well as the inner portion of the median; it descends behind the inner condyle of the humerus, covered by thick fascia and by part of the sublime flexor muscle; it then passes down the fore-arm between the flexors of the fingers and the ulnar flexor of the wrist; in the fore-arm it is much larger than the continuation of the median; it sends a branch to the ulnar side of the sublime and deep flexors, and the ulnar flexor; near the hand it sends a branch to the back of this part, to communicate with the radial branch of the

spiral, and then proceed to the outer side of the last finger; it passes deeply, confined by a ligament at its entrance into the palm, and sends a branch for the inner side of the last finger and the outer side of the third: the rest of the nerve forming the deep palmar, divides into branches, which terminate on the interosseous and other small muscles situated in the palm, and give branches to join those of the median, sent to the outer side of the first and the inner side of the second finger, and the outer side of the second and the inner side of the third.

11. Spiral nerve; it has a slight communication with the fifth cervical, but is principally formed from the sixth and seventh, and first dorsal; it gives branches to the different heads of the triceps muscle, and winds round between the inner and large heads of the triceps to the outside of the arm, and divides into two large branches; one gives off a large cutaneous branch to the outer side of the fore-arm, and then descends in the place of the radial, giving branches to the skin, and dividing to terminate on the skin at the back of the hand and the side of each finger, except the outer side of the last, and communicate with the dorsal branch of the ulnar; the other, in passing to the back of the fore-arm, gives a branch to the long and the short supinator; it is conducted between some fibres of the short supinator, and then divides to terminate in the radial extensor of the wrist and the extensor of the fingers, whilst a long branch passes on and gives filaments to the muscles analogous to the extensors of the thumb, and to the wrist-joint, but does not terminate on this part in a ganglion as in man and the baboon.

12. Last dorsal nerve; there are thirteen dorsal nerves, and their principal deviation from those in man consists in a smaller size, a more direct course, and a less distribution on the abdominal muscles, and by those at the lower part of the chest being covered by an extension of the origin of the psoas muscle; and in the anterior cutaneous branches supplying the different portions of the mamma in the female dog as well as the skin: the posterior trunks, after supplying the muscles connected with the spine, and the sacro-lumbar and longest muscles of the back, send a branch between fibres of these and the broadest muscle of the back to the skin.

13. First lumbar nerve; the anterior trunks of the lumbar and sacral nerves supply principally the parts connected with the lower extremity, the bladder and rectum; the two superior of the posterior trunks of the lumbar supply the skin as well as the sacro-lumbar and other muscles connected with the posterior part of the lumbar vertebræ; the lower five the muscles only; the posterior sacral supply the muscles connected with the posterior part of the tail. The nerves are not very different from those in man except in their number, and consequently in their conjunction a little higher or lower for forming the nerves of the lower extremity. The anterior trunks of the three first lumbar nerves give filaments to the psoas muscle, and then pass forward to terminate in the abdominal muscles and skin. The fourth gives filaments to the psoas and internal iliac muscles, and sends a branch to join one from the third to form the external spermatic on the external iliac artery, which passes through the external ring to the spermatic cord; in a female dog this was distributed on the last division of the mamma; it sends off another branch which gives a filament to the external iliac artery and then joins the fifth; the rest of the fourth passes down on the exterior of the thigh to the skin, and forms the external cutaneous nerve. The fifth receives a branch from the fourth, gives filaments to the internal iliac muscle; part of it is then joined by a large branch from the sixth to form the anterior crural nerve; the other part, after receiving a large and small branch from the sixth, becomes the obturator nerve. The sixth, having given off the preceding branches, joins the seventh and the first sacral, and a branch of the second, for forming the sciatic nerve. The junction of the seventh lumbar and first sacral gives a branch to the pyriform muscle, and a larger one to pass out at the ischiatic notch to supply the gluteal muscles and the tensor of the fascia of the thigh. Some branches derived from the first and second sacral nerves combine with the hypogastric plexus for supplying the bladder and rectum, and others from the pudendal nerves for the muscles connected with the anus and tail. A branch of the second sacral nerve joins the third for forming the anterior caudal nerve, which receives the anterior trunk of each remaining spinal nerve and passes deep in the anterior part of each side of the tail, giving off branches in its course; posterior trunks of the same nerves form a

posterior caudal nerve, which also sends off branches to the posterior muscles and skin of the tail.

14. Anterior crural nerve; it passes between fibres of the iliac muscle, then under Poupart's ligament at the inner side of the sartorius, it gives branches to this, the straight muscle, the external and internal vast muscles, and the crural, and sends off the saphenus, which descends across the thigh to the inner part of the leg, communicates with a filament from the obturator, and is continued to the foot, giving filaments in its course to the fascia and skin.

15. Obturator nerve; on emerging from the pelvis it gives branches to the pectineal muscle, the triceps and gracile, and sends a branch to communicate with the saphenus nerve; several fine branches pass down on the inner side of the thigh for the fascia and integuments.

16. Sciatic nerve; on emerging from the pelvis it communicates with the internal pudendal; it sends a branch to the internal obturator muscle, and one which gives a filament to the upper portion of the geminous, and then passes behind the tendon of the internal obturator to the lower portion of the geminous and square muscles; the sciatic passes close to the insertion of the internal obturator muscle, and upon or behind the geminous and square muscles, then behind the trochanter covered by the origin of the biceps to which it gives a branch; it sends off a large branch which divides into others for the semimembranous and semi-tendinous muscles. About the middle of the thigh it separates into the posterior tibial and peroneal nerves.

17. Posterior tibial nerve; it sends off a long slender branch which descends on the posterior part of the gastrocnemius muscle to the outer side of the leg, sends a branch behind the tendon of Achilles to the posterior tibial nerve, and is distributed on the skin at the outer side of the leg and heel. It then gives branches to the gastrocnemius muscle, and passes between the heads of this and gives branches to the flexor of the toes, the posterior tibial, and the long flexor of the great toe; it then passes down the leg on the inner side of the tendon of Achilles, and receives the branch from the long slender branch sent underneath this tendon. It passes behind the inner condyle of the tibia,

and divides into the inner and outer plantar nerves; the inner plantar gives a branch to the inner side of the first toe, and then communicates with a branch of the deep plantar, and divides for the outer side of the first and the inner side of the second, it also communicates with a branch of the deep plantar given to the outer side of the second toe and the inner of the third; the outer plantar nerve passes between the flexor tendons, and sends a nerve to the outer side of the foot and the last toe; it gives off the deep plantar, which passes underneath the short flexor of the toes, and divides into branches, and gives filaments to each of the small muscles situated in the sole of the foot, and a branch to communicate with one from the inner plantar nerve and divide for the outer side of the first and the inner of the second, and one for the outer side of the second and the inner of the third, and another for the outer side of the third and the inner of the fourth.

18. Peroneal nerve; it gives a small branch to the biceps and filaments to the fascia near the knee; it then divides, the anterior tibial nerve sends off branches to the anterior tibial muscle, the long extensor of the toes, and the long peroneal, and descends with the anterior tibial artery, underneath the annular ligament, and gives branches to the ligaments of the foot; it passes onwards, and is joined by a branch from the continuation or dorsal branch of the peroneal, and divides for the outer side of the first and the inner side of the second toe. The continuation or dorsal branch of the peroneal gives branches to the short and third peroneal muscles, and passes behind the long peroneal, and emerges between this and the long extensor of the toes; it passes over the annular ligament, and sends a branch to the outer side of the foot and the fourth toe; on the back of the foot it sends the branch to join the anterior tibial nerve; it separates into two branches, the first divides for the outer side of the second and the inner side of the third toes, the other for the outer side of the third and the inner side of the fourth.

19. Hard portion of the seventh nerve.

20. Par vagum.

21. Ninth nerve.

22. Accessory nerve; it communicates with the four superior cervical nerves, and gives branches to the sterno-mastoid muscle, and terminates on the trapezius.

23. Prolongation of the sympathetic nerve.

24. Right semilunar ganglion.

25. Ganglion, giving off the inferior mesenteric and hypogastric plexuses.

PLATE XXXIV.

Fig. I.

THE HYPOGASTRIC PLEXUS OF THE MALE CALF.

(BOS TAURUS.)

1. Prolongation of the sympathetic nerve.
2. Hypogastric plexus passing downwards to communicate with branches of sacral nerves, to be distributed on the bladder and parts connected with the neck of this, and on the rectum.
3. Continuation of the prolongation to be connected with that of the left side on the caudal artery in the single ganglion.
4. Anterior caudal nerve.
5. Posterior caudal nerve.

This figure is placed here that the plexus of a male animal may be contrasted with that of a female, for showing that in both it exists very much for supplying the bladder and rectum, and, although it is connected with the reproductive organs of both, it takes a subordinate part in their functions.

Fig. 3.

Fig. 1.

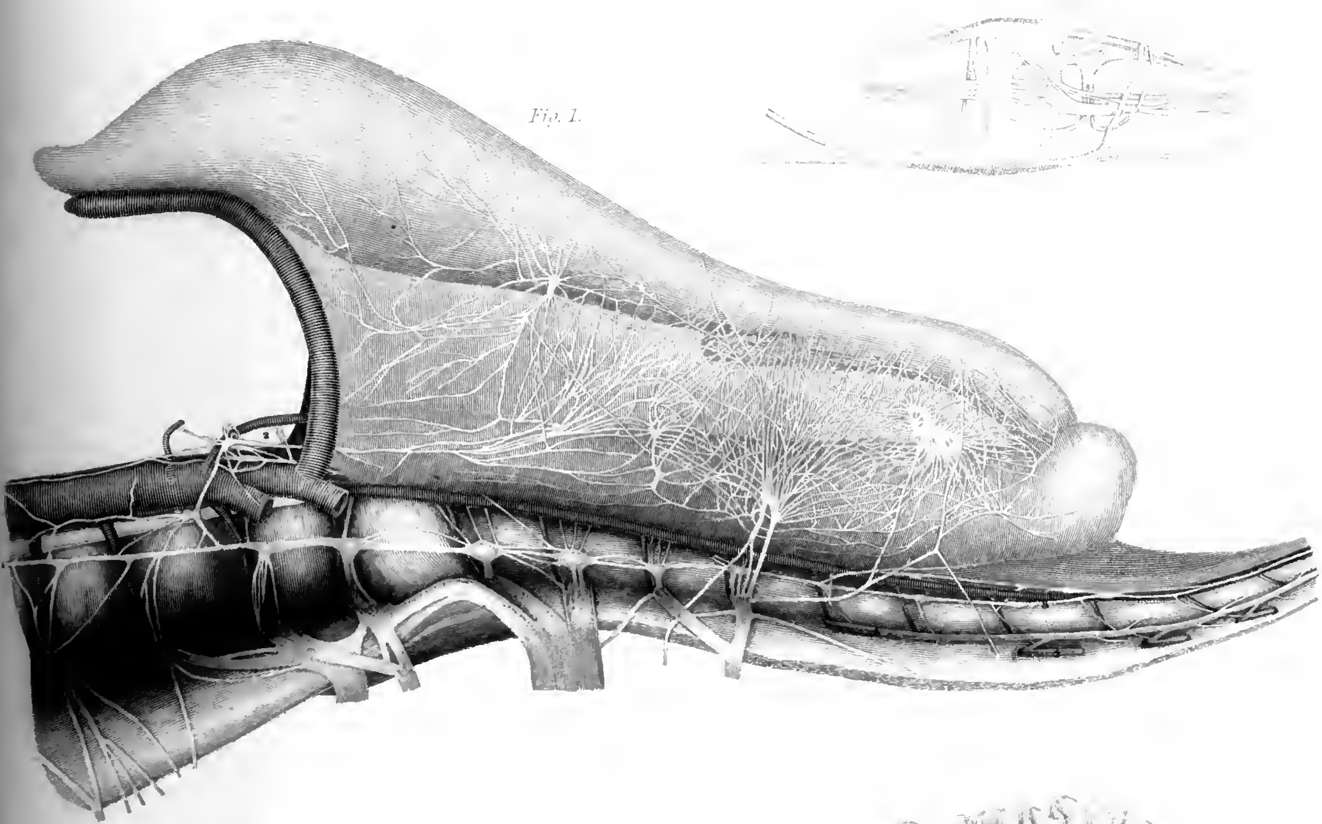
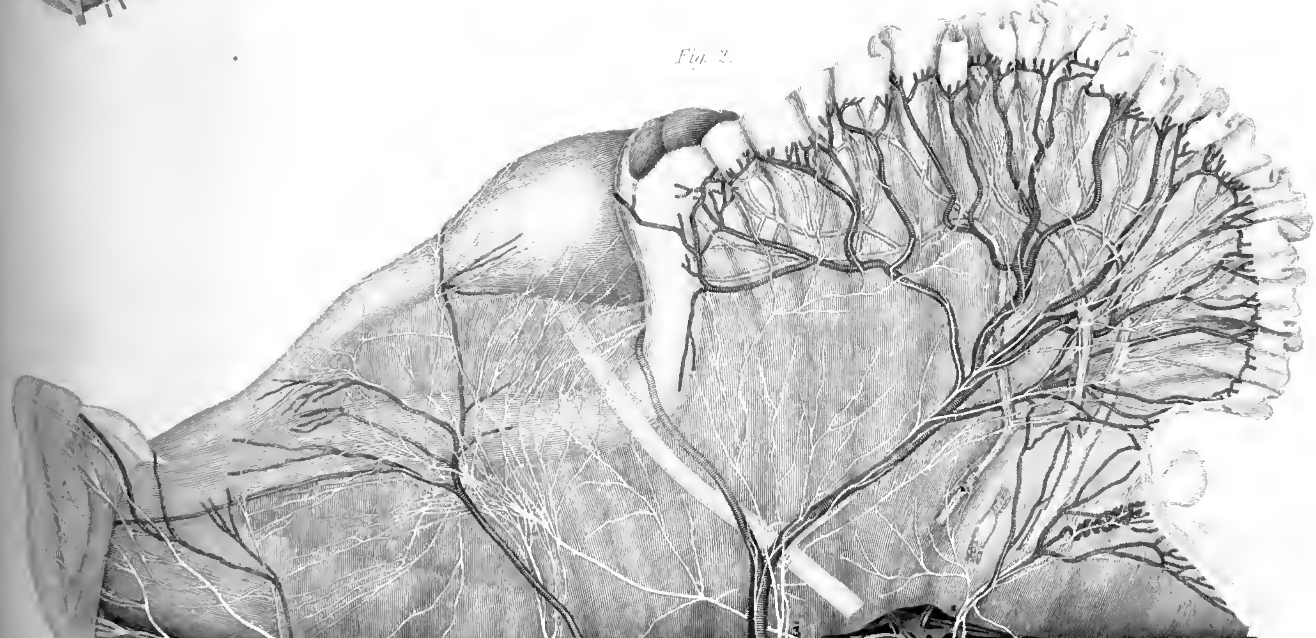


Fig. 2.



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Eng.

Fig. II.

THE HYPOGASTRIC PLEXUS OF THE SOW.

(SUS SCROFA.)

1. Ganglion of the aortic plexus.
2. Internal spermatic nerve, passing with the spermatic artery in the broad ligament to the ovary, the fallopian tube, the round ligament, and superior part of the uterus.
3. Hypogastric plexus; it gives off the uterine nerve and a smaller branch; it passes down and is joined by branches derived from a large branch of the second sacral nerve, which has been joined by a branch of the first; it then gives branches to pass with the inferior uterine artery to the neck of the uterus, and communicate with the uterine nerves, whilst the rest terminate on the bladder, vagina, and rectum.
4. Uterine nerve; it ramifies with branches of the large uterine artery and veins in the broad ligament, like the mesenteric nerves and vessels, to be distributed on the long horn of the uterus; a smaller branch is also ramified in the broad ligament. The ramifications of the uterine nerve near the uterus could not be distinctly seen without a magnifying-glass, and, as this engraving is about a fifth part of the dimensions of the drawing, they are of necessity made larger than they exist in nature.
5. First sacral nerve.
6. Internal pudendal nerve.

Fig. III.

(THE SAME.)

It shows the ganglion of the aortic plexus, and the hypogastric plexus of each side, of the natural size.

The spermatic nerves do no more than excite, and then maintain, a proper action in the ovary and its bloodvessels, for the growth of the ova, as the fecundation of these, in many instances, takes place after their exclusion.

The distribution of branches of the sympathetic nerve only to the ovary and upper part of the uterus of an uniparous animal, and to nearly the whole of the long horn of a multiparous one, makes it probable that these are necessary for the growth of this organ and the embryo, and that the conjoined hypogastric and sacral nerves more especially determine the first changes required for parturition. Whether the animal be uniparous or multiparous, or the neck of the uterus be placed high up or low down, the conjoined hypogastric and sacral nerves are directed most to the lower part of the uterus and the vagina, and render these parts more irritable than if they had been furnished by the sympathetic only, so that near the maturity of the embryo the extension and pressure gradually excite the more sentient nerves; from these the irritation is conveyed to the other uterine nerves, and produces the tetanic expulsive action: the disposition of the nerves of a multiparous animal leads to the conclusion that the parturient action commences from below in the part containing the lowest fœtus. The particular arrangement of the nerves and bloodvessels, by allowing a slower or more free circulation in the uterus and fœtus, has some share in determining the period of birth; in the multiparous animal it permits a more rapid growth of the fœtuses, as each, with the portion of uterus containing it, is supplied with blood equally and freely throughout; in the uniparous the supply of blood is more limited, the arteries and nerves becoming more influenced in succession according to the required progress of enlargement of the uterus and fœtus.

Fig. 1

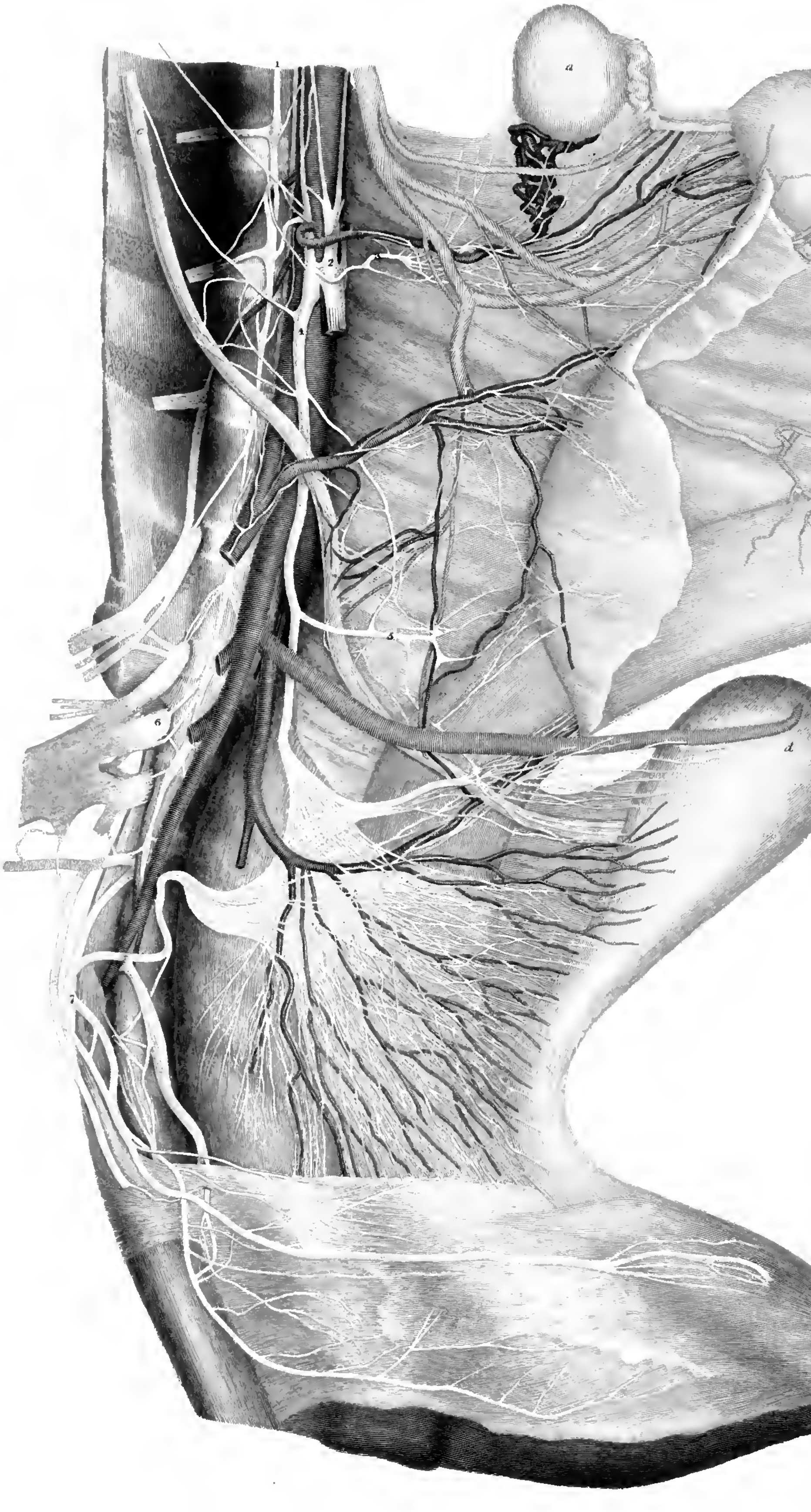

Fig. 2

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London Publ. [illegible] Bradbury & Evans

PLATE XXXV.

Fig. I.

THE HYPOGASTRIC PLEXUS OF THE ASS.

(EQUUS ASINUS.)

a. Ovary. *b.* Right horn of the uterus. *c.* Ureter. *d.* Bladder.

1. Prolongation of the sympathetic nerve.
2. Ganglion of the aortic plexus.
3. Internal spermatic plexus; it accompanies the spermatic artery and gives branches to the ovary, the fallopian tubes, and the round ligament; a branch was traced a considerable way down on the lining membrane of the uterus on the left side.
4. Hypogastric plexus; it gives off the uterine nerves, and communicates with branches of the fourth and fifth sacral nerves, and in another preparation with the sixth; it then sends branches to the remains of the umbilical artery, the lower part of the uterus and vagina, and communicates with the uterine cord, and then terminates on the vagina, bladder, urethra, and rectum. After its combination with the sacral nerves, it was intermixed with very dense membrane.
5. Uterine cord; it receives a branch from the hypogastric plexus, and is joined by another, and then by a third from the point of union of the hypogastric plexus with branches of the fourth and fifth sacral nerves; it sends filaments

in the broad ligament to accompany the branches of the uterine arteries and veins to the uterus.

6. First sacral nerve.

7. Internal pudendal nerve.

Fig. II.

(THE SAME.)

It shows the full size of the ganglion of the aortic plexus, and the hypogastric of each side; and the hypogastric plexus larger on the right side than the left.

SUMMARY.

The brain is more or less spherical or lobulated in all animals; in man, at the upper part of its hemispheres, there is an extensive fissure, and one more or less deep in many of mammalia; but in some of these and the other classes there is a very little, if any, separation. Convolutions answer a particular and not a general purpose; they are very deep in man, and some of mammalia; but in others and the several inferior classes they hardly exist. The great commissure is very extensive in man and such of mammalia as have the hemispheres high and large; it faintly exists in others, in which the lobes only just inclose the lateral ventricles; it is not present in the three lower classes. Ventricles vary in all the classes; the lateral has a posterior horn in simiæ proportioned to the posterior lobe, so that in some it is a mere chink; in birds it extends more posteriorly, at which part its parietes are very thin; it is placed anteriorly in amphibia and fishes. The third ventricle lies between the thalami in mammalia and birds; in birds it extends into the optic lobes; in amphibia and fishes it is continued from the same surface with the lateral. The fourth ventricle exists in all; and in birds, amphibia, and fishes, extends into the optic lobes and cerebellum. The transparent septum exists in mammalia only; in birds, the striated septum supplies the place of it and the great commissure. The fornix exists in mammalia only; in birds, the floor of the lateral ventricle supplies its place. The great hippocampus exists in mammalia, there is a smaller eminence resembling it in birds, but not in the other classes. The striated body exists in the three superior classes; in mammalia it is similar to that in man, but very different

in shape in birds and very small in amphibia. The thalamus exists in the three superior classes, it is smaller in birds than in mammalia, and very small in amphibia. The soft commissure depends upon the presence of each thalamus; there is a large one in mammalia, but is placed more in the middle of the side of the thalamus than in man; it is very tough in the turtle. The anterior commissure exists in the four, the posterior in the three, superior classes. There is a pineal gland in mammalia and the turtle. The quadrigeminal bodies are distinct in mammalia, but vary, the nates being either larger or smaller than the testes: they are solid at birth; in birds they are flattened and large, and have no distinction like that of the nates and testes, and contain a ventricle in each communicating with the third; they also exist as hollow bodies without any anterior or posterior separation in amphibia and fishes. The base of the brain is divided into lobes in man and simiæ, and in the porpoise, but in most others there is very little, if any, distinction; the pituitary gland exists in the four superior classes. Two distinct mammillary eminences exist in man, but they are very generally conjoined in mammalia; there is a prominence in birds; they do not exist in amphibia, they are however not only present but separate in fishes. The cerebellum exists in the four superior classes; in the invertebrate its presence is doubtful; it has large lateral lobes compared with the middle, and is large in proportion to the size of the body in man and simiæ; the lateral lobes compared with the middle ones are smaller in mammalia generally; it is convoluted throughout; in birds, it consists principally of a middle lobe, to which is attached on each side a small one like the lobule appended to the lateral lobe of simiæ and other animals; it is convoluted, and has a ventricle; in some of the amphibia, as the turtle, it is hollow, and the parietes are thin, in several, it is a mere rudiment. In the cod, it has a small ventricle, and consists principally of a middle lobe; in the skate it has a ventricle. The annular tubercle is largest in man, in mammalia it is proportioned to the size of the crura of the cerebellum more than to the crura of the brain. The trapezoid body exists in mammalia; it is composed of transverse fibres externally, and internally of the tract of the larger portion of the intermediate layer of the exterior region of the brain, after it has been joined by the tract of the first convo-

lution of the intercedent region. It gives origin on its outer side to the smaller portion of the fifth and the hard portion of the seventh, and on its inner side to the sixth, and by its extension downwards to the ninth. Part of it resembles the olivary body, and in all other respects, except in form, it is analogous with the most posterior or oblique tract of the annular tubercle in man, which is the continuation of the tract of the larger portion of the intermediate layer of the exterior region of the brain after it has received the tract of the convolution of the intercedent region. This oblique tract of the annular tubercle on its outer side also gives origin to the smaller portion of the fifth, and lower down to the ninth, and in the lower part of its median side it gives origin to the sixth nerve, and its continuation down the oblong medulla includes the olivary body, and from the inner side of this gives origin to the ninth. The trapezoid body is not distinct in birds, and does not exist in amphibia and fishes. The oblong medulla is larger in mammalia in proportion to the size of the brain than in man, but particularly in the other classes; small olivary bodies exist in the monkey; the other eminences in the four superior classes are more or less indistinct.

The olfactory nerve, except in animals not having a nose, exists in the four superior classes; it arises from the anterior lobe of the brain when it is small, but extends further backwards when it is large; it is of small size in man and simiæ, and very large in mammalia generally; it varies in the form or absence of the ganglion in birds and amphibia, and the shape of the ganglion in fishes. The optic nerve exists in the four superior classes and many of the invertebrate; in the three superior the tract is connected with the thalamus, and in the four with the optic lobe, and in mammalia and birds with the true visual tract, and with the mammillary eminence, or the prominence in the place of it, and in mammalia with the geniculate body. The commissure of the two tracts varies; it is large in man, less in mammalia, and still less in amphibia and fishes; there is an interchange of fibres from each tract in it, but in some fishes there is a complete decussation of the two nerves. The third nerve arises in man and mammalia from the inner side of the crus of the brain, and further from the smaller portion of the intermediate layer of the exterior region of the brain; in birds, amphibia, and fishes, from the oblong medulla, near the same place; in all, it supplies

similar muscles and contributes to the ciliary nerves, which are not so numerous as in man, and do not always proceed from a ganglion. The fourth arises behind the optic lobes in the four superior classes, and has the same destination in the superior oblique muscle; in man, it communicates with the lachrymal nerve. The fifth arises principally from the oblong medulla in the four superior classes, half of the larger portion in man, mammalia, and birds arises from a similar involuntary centre, the other half from the sensitive centre in the floor of the fourth ventricle. The smaller portion in man arises from the oblique tract of the annular tubercle, and in mammalia from the trapezoid body; it is not so distinct in the other classes. Some interchange similar to that in the Gasserian ganglion exists in all. There are always three trunks, but in some fishes more. The first trunk supplies the parts about the orbit and fore-head, the superior nasal extends through the nose to the skin near the anterior part of this organ in mammalia, and in birds and amphibia to the anterior portion of the palate and beak. The second trunk gives branches to the temple and horn, the inferior part of the orbit, the nose, the palate, and teeth; its principal portion terminates in the upper lip or the part answering to this, and is usually larger for making the snout an instrument of feeling when the nerves of the toes are less. The third trunk supplies the skin on the anterior surface of the external ear, and part of the temple and face in mammalia; the inferior dental supplies the teeth and bone of the lower jaw, and the part corresponding with the lower lip in the four superior classes; the mylohyoideal nerve in some of mammalia sends a branch into the face to communicate with the hard portion; it is very small in the goose and very large in the pelican: in the turtle there are two branches, and in the snake three; the other branches of this trunk vary, according to the presence or absence of muscles and other parts, or the necessity for modified functions. The gustatory, as a large nerve for the sense of taste, exists only in mammalia, a branch analogous to one given by it to the lining membrane of the mouth may be resembled by those of the inferior dental in the other classes. In some fishes the fifth gives off the auditory nerve, and furnishes a large posterior branch for communicating with the spinal nerves, especially those of fishes. The sixth exists in the four superior classes with very little difference except in size,

when it supplies supernumerary muscles; in man, it arises from the oblique tract of the annular tubercle, and in mammalia, from the trapezoid body; in the other classes it arises from the oblong medulla. It communicates with the sympathetic in man and the monkey in a similar manner, but in other animals, rather differently. The auditory is present in the four superior classes; it arises in all from the oblong medulla, and in mammalia a portion of it is traced to the surface of the fourth ventricle; in some fishes it is a branch of the fifth, it may therefore be presumed that much difference between it and the fifth does not generally exist. Its distribution varies in some degree according to the shape of the labyrinth. The hard portion exists in the three superior classes; it arises from the oblique tract of the annular tubercle in man, and from the trapezoid body in mammalia. In birds and amphibia its size is less than in mammalia, as the muscles of the face are absent. The glosso-pharyngeal nerve exists in the four superior classes; its origin is from the involuntary centre in man, mammalia, and birds, and from analogous parts in amphibia and fishes. In mammalia, besides the other distributions, it sends filaments into the tympanum; it supplies the back of the tongue and the anterior part of the epiglottis; in birds it is larger in proportion to the par vagum than in any of the other classes, and communicates more with the sympathetic; it gives the branch to the glottis, which in mammalia is furnished by the par vagum, and supplies the tongue as far as the tip; in amphibia it is in some respects the same as in birds; in the snake it supplies the glottis, whilst the par vagum does that of the turtle as in mammalia; in fishes, its origin is connected with that of the par vagum, and it supplies the first gill and part of the membrane of the throat; in three classes it is connected with the organ of hearing, but not in the turtle, the par vagum rather supplies its place. The pharyngeal plexus is the most complicated in man, next in mammalia; in some birds and amphibia, as the pelican, crane, and snake, the combination of nerves is much greater than in the goose and turtle; but in fishes the pharynx is supplied by branches of the par vagum along with the stomach. The par vagum exists in the four superior classes, and is not very different; its origin is from the involuntary centre in man, mammalia, and birds, and from analogous parts in amphibia and fishes; it, as well as some

of its branches, is larger, according to the extent of the parts to be supplied; it gives off one or more lateral or dorsal branches in fishes; in mammalia, the external and superior laryngeal and recurrent nerves are similar to those in man, but their branches are rather more combined before their termination; in the jaguar, the superior laryngeal as well as a minute branch of the external laryngeal pass through separate foramina in the thyroid cartilage; the recurrent nerves differ in birds and amphibia from those of mammalia in supplying the œsophagus in a greater degree than the larynx. In fishes, a recurrent branch also exists, which winds round one of the branchial arteries to supply a muscle connected with the motion of the gills; the pulmonary branches are similar in the four superior classes, but are destined for the gills in fishes instead of the lungs in others. The cardiac plexus is formed of the sympathetic, par vagum, and recurrent in mammalia: it is more complicated in man; it is similar in birds; in amphibia it is formed more of branches of the par vagum; in fishes, its state has not been determined. The par vagum supplies the stomach in the four superior classes, the branch connected with the cœliac plexus for keeping all the small intestines and the beginning of the colon under the influence of the brain exists throughout mammalia; a communication between a branch of the par vagum and the cœliac and splanchnic nerves exists in birds; in the snake, communications also exist; in fishes there are also some. The ninth exists in the three superior classes, in man it arises from the continuation downwards of the oblique tract of the annular tubercle, and in mammalia from that of the trapezoid body; it supplies the muscles of the tongue and others connected with the hyoid bone and thyroid cartilage. In some birds, as the goose and turtle, it resembles very much that in mammalia, but in others, as the pelican, crane, and snake, the glosso-pharyngeal, par vagum, and ninth are so conjoined, that it is very difficult to determine the destination of each. The accessory nerve exists in man and mammalia; in birds, it is not present, unless the lengthened origin of the par vagum may be considered as a part of it; in some of amphibia it may be seen, as in the turtle, but not in fishes.

The spinal cord is nearly the same in the four superior classes; in the invertebrate there is a cord or ring in the place of it, analogous to its nerves and ganglia;

it varies either in breadth or length, according to the required motion of the spine, and the number and size of the nerves; it may be short and broad, or long and narrow, with enlargements in places from which larger nerves are to proceed; it may form a longer or shorter cauda equina. In birds, it appears knotted, and has its dorsal part closely surrounded by bone, and has a lumbar ventricle; it reaches to the tail in birds, and generally in amphibia and fishes.

The number of spinal nerves varies in each class. There is an anterior and posterior origin of nerves from each portion of it in the four superior classes, a ganglion is generally formed by the posterior, this however may not only vary in structure, in being either thready or fleshy, but in the disposition of the nerves attached to it, as in the cod. Ganglia are both fleshy and thready in mammalia, fleshy in birds and amphibia, but much more indistinct in fishes; in the skate, a very small ganglion is attached to each posterior fibril, and in the cod, most of the anterior and posterior bundles, after leaving the spinal cord, are not only arranged differently, but the ganglionic structure is very equivocal. In the ventral surface of the cord of the lobster there are ganglia, but not in the ring of the crab, nor in the nerves proceeding from it. In almost the whole of mammalia, the number of cervical nerves is the same as in man; in birds, it is very various; also in amphibia; in some there is very little distinction as well as in fishes, the nerves of the toes covered by a hoof are smaller in proportion to those covered only by cuticle. The phrenic nerve exists in mammalia only. In animals having upper extremities, the lower cervical and first dorsal nerves generally form an axillary plexus from which these parts are supplied; it is composed of more or fewer spinal nerves, and generally sends off similar trunks, which are larger or smaller, or differently arranged, according to the size, and the required direction of the muscles. In mammalia, birds, and some of amphibia, as the turtle, the axillary plexus is produced by the lower cervical and first dorsal nerves; in the frog there is one large nerve instead of the plexus; in the snake it is absent; in fishes there is some resemblance of it, and particularly in the skate. It divides into similar nerves in mammalia and birds; in the turtle they resemble most the median, spiral, and circumflex; in fishes they hardly bear any comparison. In mammalia, the

number of dorsal nerves is seldom fewer, but often greater, than in man. In birds it is generally fewer, as well as in amphibia; but in snakes and fishes a distinction cannot be made. Each nerve varies according to the extent of parts supplied. The lumbar, sacral, and caudal nerves of mammalia, are similar to those in man, the number of lumbar is generally greater, that of sacral less; from some of these a plexus is formed, which sends off the anterior crural, obturator, sciatic, and several smaller nerves. Similar nerves are given off in birds and amphibia, but vary to suit the difference in the form and size of the muscles, and the required sensibility of the integuments. In mammalia, the tail is supplied by an anterior and posterior caudal nerve on each side; in birds, amphibia, and fishes, by numerous small nerves issuing from the spinal cord to the end of the tail.

The sympathetic nerve is distinct in the four superior classes; it varies in having a more or less close or open texture. In mammalia, there is a superior cervical ganglion, it is very small in birds, very distinct in the snake, but not in the turtle and fishes; in man, it sends branches to communicate with the sixth, the Vidian nerve, and the Gasserian ganglion; in the monkey, it is the same, but in mammalia generally there is some variation; in birds and amphibia it communicates with the ninth, the par vagum, the glosso-pharyngeal, the hard portion and fifth; two of the branches passing upwards may be compared with the Vidian; in fishes there is a communication with the par vagum and fifth, and as cervical ganglia do not exist, the first may be compared with the thoracic sending off the splanchnic nerves. In mammalia it communicates with the nerves of the pharynx, and supplies the branches of the external carotid, and the salivary glands; it also usually communicates with the glosso-pharyngeal, par vagum, ninth, sometimes with the accessory, suboccipital, and one or two of the superior cervical nerves. The prolongation descends to the first thoracic ganglion, sometimes becoming connected in its course with one or more ganglia in the neck; it is either separate from, or adhering to, the par vagum; in birds there is a very slender branch sent with the carotid artery; in the pelican, that of each side becomes joined, and then accompanies the united trunks of the carotid, and divides again to communicate with the ganglion of the last cervical nerve but one of each

side; in the turtle there is a strong prolongation, but in some species it adheres so closely as to appear like a part of the par vagum. In man, branches from the cervical ganglia and prolongation communicate with the cervical nerves; but another communication is formed by branches sent up with the vertebral artery; in mammalia and birds, this is the chief mode of connexion with the cervical nerves; in the turtle, branches are sent upwards, but not in a distinct spinal canal; in the snake, the superior cervical ganglion sends a branch to the par vagum, which may be compared with the prolongation, but it cannot be separated again; the principal way of communication is by a branch sent downwards in an imperfect canal close to the spine; in fishes it does not exist. The first thoracic ganglion exists in the four superior classes; it is generally very large in mammalia, it is small in birds, in the turtle it is membranous, but in the frog and snake there is not a distinct ganglion; in fishes it is large, and appears as the most superior ganglion. From the cervical and first thoracic ganglia in man and some species of mammalia, and in others also from succeeding thoracic ganglia, as well as from the par vagum, the cardiac nerves are given off; in birds these proceed from the first thoracic ganglia and the par vagum; in amphibia they proceed most from the par vagum; in fishes they are not ascertained. In mammalia the prolongation is continued down the thorax, either flat, like tape, with small ganglia imbedded in it, or in a narrower and thicker form with more distinct ganglia, for communicating with the spinal nerves; in birds the thoracic prolongation is double to some distance; in the turtle it is also double, but the ganglia are very small and connected with the spinal ganglia as in birds; in the snake it is a fine thread communicating with each spinal nerve, but not forming ganglia; in the frog there are not any ganglia, but at the connexion with each spinal nerve there is a cluster of pearly vesicles containing cretaceous matter; in fishes there are small ganglia at the point of connexion with the spinal nerves. In man, from the thoracic portion the splanchnic nerve is given off; in mammalia it is in some instances similar to that in man, but generally it remains connected with the prolongation throughout the thorax; a smaller splanchnic nerve is also given off, but it is not more worthy of distinction than many other branches; in birds there are two principal splanchnic

nerves, the upper accompanying the cœliac artery, the lower communicating with the renal capsule, and accompanying the superior mesenteric artery; the semilunar ganglion is very small; in the turtle there is the same disposition, but instead of a semilunar ganglion, a plexus is present; in the snake this plexus is more extended, and has still less of the form of the ganglion; in fishes there is a considerable fleshy ganglion; whether there be a semilunar ganglion or a plexus, there is a similar distribution to the several organs. The lumbar and sacral portions in mammalia resemble those in man; the ganglia in birds, amphibia, and fishes, are much smaller and more indistinct. The spermatic nerves in mammalia are generally less complicated than in man; in birds they proceed from the lower splanchnic nerve, at its connexion with the renal capsule; in amphibia numerous branches are given off to the ovary and the long oviducts; in fishes they proceed from the sympathetic, at the lower part of the abdomen. The renal nerves in mammalia are generally rather more simple than those in man; in the other classes they have a more extended origin. The termination of the sympathetic in the single ganglion is continued on the caudal artery into the tail. In mammalia, the hypogastric plexus is similar to that in man for supplying the reproductive and urinary organs, and the lowest portion of the intestines, in the male and female, after a conjunction with some of the sacral nerves; its branches are, therefore, differently disposed according to the sex; in birds it is resembled by the long nerves, formed by the spinal and sympathetic for the parts about the cloaca and tail; in amphibia it is still more simple.

The nervous system has a modified consistency in accordance with that of the body. However different the forms of animals may be, there are appropriate arrangements of the centres for giving the required powers, and nerves adapted by size and length for allowing free motions of all the parts, either in the interior of the body for performing vital functions, or in the exterior for completing sensation and motion. In the organ for each sense there is a resemblance of structure and shape appropriate for its peculiar function. In the mode of the origin of the nerves of the special senses there is a considerable similarity in the several classes of animals, but there are also degrees of complexity. There is not much variation in the local origins of the

common sensitive or motive nerves, and it does not account sufficiently for their more or less exalted sensitive or motive properties in different animals. The structure of the common sentient organs and the muscles, the size of their nerves and the extent of their local origins, give the peculiarity of each degree of sense and of the motive power, but the continuations of the tracts from the local origins and the extent of their communications with the convoluted surface of the brain, give the sensorial quality of each sense, and the connexions of the motive tracts with the convolutions determine the variations of voluntary motion. According to the extent of the local centres, and their connexions with the convolutions, sensations vary in every degree, from a simple perception to the highest quality ever experienced. Voluntary motion may also vary in mere quickness or power up to the accomplishment of the most correct and graceful evolutions. It must be apparent that, however great the resemblance of the form of animals may be, and of the organs belonging to them, and even of the parts of the nervous system supplying them, in such respects only they approach each other for the performances of similar animal functions. The greater difference in the scale of creation must be looked for in the larger proportions of the brain, by which all their powers become gradually increased and brought nearer to the higher qualities of the intellect. It is probable that for the higher sensitive or motive qualities of particular organs required for the instinct in fulfilling the special purposes of some creatures, very minute sensorial centres are present in the brain.

Besides the previous acquaintance with the centres and nerves, it may be proper to notice some points relating to their texture, and their inherent and acquired properties.

The investing membranes are generally similar in each class of animals, but there are deviations which partake of the peculiarities of other parts of the body, as in the colour of the skin and hair, and the pigment of the eye; there are also modifications of texture. Most commonly a nerve is white and glistening, but has sometimes a tint inclining to yellow or blue. In the pelican, the nerves supplying the beak are covered with a black membrane. It has different colours in invertebrate animals, and is not always similar in the same species of the vertebrate, but varies like the black or dark

pigment in the membranes of the brain of sheep. Almost the whole nervous system of the crocodile is enveloped in the same black membrane. This variation shows that as the internal parts of the nerve are white, it is an adventitious production connected with peculiarities of the animal.

There is a great variation in the texture of the component parts of very numerous animals, and as the nerves must be connected with them, so there is generally a proportionate degree of firmness or softness. Many nerves have been constituted with a view to the mechanical operations in which they must be involved. When all the organs have a softer texture, the nerves generally partake of a like consistency, and when a greater capability of resistance is required, it is produced by a stronger neurilema or peculiar attachments of the cellular membrane.

If nerves had been altogether passive, they must have been very long for their adaptation to moving parts, and very inconveniently placed amongst them. As their medullary portions will not bear either extension or pressure, they require a particular construction. The medullary fibres have generally a tortuous appearance, whilst surrounded by the neurilema in an animal recently dead, and become straight by extension, and tortuous again by relaxation; there is an elasticity of the neurilema, but not in the same degree of the medullary fibres, the elasticity allows a nerve to be extended with the surrounding structures and shortened with their relaxation, and thus to become accommodated to the changes of position caused by the motions of the body. In the jaguar there is a great elasticity of some nerves, particularly of those of the pharynx and the sterno-hyoid and sterno-thyroid muscles; it is very little in those of the tongue or in the par vagum and accessory of the same animal. There is a tortuous appearance of the numerous small nerves in the very extensible parts of the snake; it is produced by connecting processes of the surrounding cellular membrane, which in returning to its contracted state after extension draws them into folds, and by this contrivance they are easily elongated when the body is in motion, or distended with food. The tortuous state of the medullary fibril, depending on the neurilema, and that of the whole nerve on bands surrounding cellular membrane, answer similar intentions.

The disposition of the fibrils of a nerve is altered in a ganglion according to the required uses; ganglia exist as centres of origin or connection of nerves from, to, and through which impressions proceed. They combine and harmonise different nerves, or allow a large one, as the splanchnic, to be diffused in a wider centre, giving it a firm attachment in a convenient situation for furnishing the very numerous branches to the viscera, whose extent and varying condition require a particular distribution. They may, throughout in some animals, or only in parts of others, effect greater or less changes according either to the complexity or simplicity of arrangement of the fibrils of the nerves entering them, by their more or less close structure, and the quantity of the red intervening matter; they may therefore be very slightly varied as to their constituent parts in many instances, from the nerves entering them, the disposition of the fibrils being merely altered in the more open or plexiform ganglia, or they may be entirely changed in the more close or solid ganglia, no vestige of the fibrils remaining. In close ganglia of the sympathetic nerve, the nervous fibrils being obliterated, it is presumed that the perceptiveness of the organs supplied by their branches is of a peculiar kind. When the fibrils are not entirely obliterated in the ganglionic matter, the perception of the organ receiving its branches approaches nearer to that allowed by the cerebral and spinal nerves, and still nearer when the ganglia have almost entirely the form of a plexus. So in the ganglia of the spinal nerves, the greater the quantity of red matter in which the fibrils of the nerve are subdivided, the more the perceptive faculty is modified.

A plexus which is in the place of the semilunar ganglia in the turtle, snake, and crocodile, is regarded as belonging to the more open or thready ganglia. The arrangement to be generally considered as a plexus in various parts of animals is in much wider meshes. The more intricate these are, the nearer they approach the functions of ganglia. All the intermediate changes are connected with altered functions for keeping up a more concentrated exciting power, or a greater or less communion with other nerves: they are modifications of ganglia, to which they are, in some degree, subservient, for they are frequently placed as the first arrangement of branches proceeding from ganglia to their destination. Plexuses, however, need not

arise from ganglia. A plexus may associate several branches of the same or of different nerves, but it does not prevent each separate nerve from actuating any part for a single purpose, whilst it combines the whole for a more general and complicated operation.

Plexuses are formed in the spinal nerves for associating in action the several sets of muscles, as the axillary in the upper extremity, and the sciatic in the lower; sometimes, however, a single nerve exists instead of the axillary plexus. They also associate cutaneous nerves in the pelican. There is a necessary order observed with respect to the nerves entering the plexus, inasmuch as all of them do not communicate equally with each other, but only so as to produce particular associations in parts.

Plexuses are not necessary when there are many legs, as in the centipede, but only when there are many muscles for a single limb, which has extensive and complicated actions. The axillary plexus is much less complicated in the lion, whose muscles have simple uses, than in many other animals, which have heavier fore-quarters to sustain.

The first dawn of life is excited into action either through some provision in the body of the parent, or some external agent, as heat applied to the egg. The excited living power produces the first evolution of organic structure, and shortly afterwards the heart becomes apparent, which soon and ever after takes a prominent part in perfecting the functions of the whole body, but most particularly in those of the nervous system; its influence is not, however, equal in all animals, as so much also depends upon the warmth and coldness of the atmosphere and other circumstances; nevertheless the heart generally, when it has been once brought into action, continues so until death; and although life may persist without its influence a longer time in some instances, yet in others it is very speedily extinguished. It therefore appears that the essential part of the nervous system may lie dormant in the egg, also in the more mature bodies of some animals, but that generally, when it has been once excited, it requires a perpetual stimulus for keeping it in connexion with the body.

The functions of the nervous system are promoted by their contiguity to moving

parts. In man particularly, the lower portion of the œsophagus is surrounded by branches of the par vagum; the two trunks are thus differently combined, but it is probable that the nerves are at the same time made capable of being excited by the passage of the food along this canal, preparatory to their active functions in the stomach. In invertebrate animals the œsophagus is generally surrounded by the beginning of the nervous system, which in the leech during the act of sucking is agitated and stimulated, the full stomach also distends and excites the contiguous nerves. The large artery passing between the divisions of the nervous cord as in the lobster, and through the ring as in the crab, have a similar influence.

The functions of the nervous system in the higher classes of animals are also promoted in a considerable degree by the activity of the sanguineous system, and in some parts for special purposes by peculiar arrangements of the vessels. The rete mirabile shows that a modification of the supply is necessary for the brain in different animals, a forcible current is, however, continued through this structure, for on dividing the carotid arteries in the calf, the blood sent by the vertebral, returns, pulsating through the upper divided ends. Whether the arteries reach the brain from the carotid by continuous branches, or through the rete mirabile, they are ramified in the pia mater and the cellular tissue containing the cineritious and medullary matter. A greater proportion circulates in the cineritious matter; but some vessels containing red blood are found in the medullary; it is, however, sustained principally by the colourless parts. The spinal cord appears to require a similar circulation. The bloodvessels of the nerves ramify on the neurilema, and throughout their course are moderately supplied with blood from neighbouring branches, but receive more during their excitement, and it is most probable that they are generally sustained by the colourless parts. Particular arrangements of the vessels are necessary for completing the functions of some nerves, as in the cavernous form of the veins of the nose, the choroid coat of the eye, and in others in various parts of the body.

Ganglia are supplied with blood by neighbouring arteries; in their healthy state they do not require mucn, but are supported chiefly by the colourless parts; it is probable tnat, wnen tney are excited, numerous vessels containing red globules become

apparent, during their active healthy functions, in inflammatory diseases, and after the use of particular medicines. On a minute injection after death, the ganglia are very vascular, but this is not their ordinary appearance.

The supply of blood is regulated by the nerves during the action either of a single organ, or of the whole body, for the heart itself can only circulate it generally by a uniform impulse over the system; and without this influence of the nerves, any change in the action of an organ would misdirect it, and produce confusion. The nerves and bloodvessels, by ministering to the functions of each other, preserve the balance of both, the impulse of the blood exciting the nerves, and these the contractility of the coats of the vessels, and preventing over-distension. Any moderate excitement may be confined to the nerves and bloodvessels of the part, but one more extensive is communicated generally to the nervous and sanguineous systems.

Some of the veins are accompanied by nerves, and particularly those underneath the skin of the extremities by the cutaneous, and in the inferior vena cava of mammalia by the right phrenic. In birds the par vagum accompanies the jugular vein instead of the carotid artery, as in mammalia. The veins are scantily supplied with nerves, but when they furnish blood for secretions, or other important purposes, they receive a more copious quantity, as when filaments from the hepatic plexuses supply the branches of the vena portæ. It is probable that all the veins are influenced by the state of the nerves, and become over-dilated, not only by any obstruction to the return of blood at the viscera, but by the want of tone, which a diminished nervous power produces; and as the pores of the skin are relaxed in some instances from the same cause, profuse perspiration may take place. It is, however, probable that several nerves accompany veins, more on account of their safety than for the performance of any specific function, and that the par vagum accompanies the jugular vein in birds, that it may have a more free position than if it had accompanied the carotid artery in the more limited receptacle upon the middle of the spine; but by adhesion to the vein it is secure from the action of the œsophagus in conveying the food, because the force of the pressure falls principally on the returning blood. When, however, the veins assume the place of arteries, nerves accompany them for the same purpose they do the

arteries, for exciting them, and connecting them more particularly with the functions of the organ on which they are about to terminate.

After the birth of an animal, something deleterious to the nervous system is generated with the nourishment, and requires to be eliminated, for preserving the vital properties of the body. This is effected principally by respiration; it is also assisted by the liver and kidneys, and the absorbent system; and these organs are evolved in a greater or less degree, according to the extent and quality of the nervous system. Although the nervous system cannot continue its functions without the lungs or some compensating organs, these are not made for the nervous system only, as every part of the body requires a share of blood purified in the same manner, that there may be an harmonious action throughout.

Independently of the blood, there is a more enduring vitality of the solids in some animals than in others. Amphibia with a very slow circulation of blood, moderately influenced by oxygen, under peculiar circumstances can retain it much longer than birds and mammalia. The shorter the period elapsed since the fœtal state, the less liable is the body to death from a want of the changes in the blood by oxygen, in some measure because the nervous system is not so fully developed, and has lately been so accustomed to venous blood, but principally because some remains of the vicarious passages continue, and keep up a circulation, which the passive lungs would otherwise have prevented.

In considering the functions of the nervous system, it is necessary to look further than the organs of the circulation, the influence of the blood itself, and the several processes by which the nourishment necessary for preserving vitality is to be prepared and purified. The material nervous system must have a source of animation for its own purposes, for enabling it to perform its higher functions, and this is the nervous element which must, however, be continued in efficiency by oxygenised blood. Through this nervous element the nervous system becomes capable of acting with the next higher spiritual element in animals, for producing the instinct, the will, the sensitive, and involuntary powers. However difficult the comprehension of the nature or even of the presence of spiritual agents may be, their existence, efficiency, and power, must

nevertheless be admitted. The physiologist must go beyond tangible and visible objects, if the functions of the nervous system are to be understood.

Without the extreme care and skill bestowed on the drawings by Mr. West, and on the engravings by Mr. Finden, the utility of the work must have been very much diminished. The drawings were finished as highly as possible, and made of the natural size of the subjects of which they are faithful and beautiful representations. Reductions of these were undertaken by Mr. West for the engravings, which have been executed with so much nicety, that by the use of a reading-glass they possess most of the advantages of larger plates.

THE END.

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